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VOLUME 119 NUMBER 3085

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A Report on the Present Functions and Operations of the National Bureau of Standards

Their Evaluation in Relation to Present National Needs and Recommendations for the Improvement and Strengthening of the Bureau

Excerpts from a report to the Secretary of Commerce

ON OCTOBER 15, the committee appointed to study the functions and operations of the National Bureau of Standards submitted its report and recommendations to the Secretary of Commerce. Because of its important implications in regard to all scientific organizations under the Federal Government, we print here the main recommendations, evaluations, and the summary of this report. The members of the committee were as follows: Mervin J. Kelly, Chairman (Bell Telephone Laboratories), appointed by the President of the National Academy of Sciences; John C. Green, Executive Secretary (Department of Commerce), appointed by the Secretary of Commerce at the request of the Committee; Lee A. DuBridge (California Institute of Technology), nominated by the American Institute of Physics; William L. Everitt (University of Illinois), nominated by the Institute of Radio Engineers; James W. Parker (Detroit Edison Company), nominated by the American Society of Mechanical Engineers; Kenneth S. Pitzer (University of California), nominated by the American Chemical Society; J. Barkley Rosser (Cornell University), nominated by the Policy Committee for Mathematics; Guy Suits (General Electric Company), nominated by the American Institute of Electrical Engineers; Clyde Williams (Battelle Memorial Institute), nominated by the American Institute of Mining and Metallurgical Engineers; and Abel Wolman (Johns Hopkins University), nominated by the American Society of Civil Engineers.

Functions and Authorities

The functions and activities of the National Bureau of Standards are undertaken in conformance with legislative provisions. The Organic Act (31 Stat. 1449), establishing the Bureau on March 3, 1901, was extensively amended in 1950 (64 Stat. 371, 5 U.S.C. 271–286) and now authorizes six broad functions: (1) the custody, maintenance and development of national standards of measurement and related measurement problems; (2) the determination of physical constants and properties of materials; (3) the testing and the development of methods for testing materials, mechanisms and structures; (4) cooperative activities relating to standard practices incorporated in codes and specifications; (5) advisory services to Government agencies on scientific and technical problems; and (6) the development of devices to serve special needs of the Government.

In the carrying out of these functions, the Act also provides authority for undertaking "specific activities" that are mainly for the purpose of giving the Bureau the necessary capabilities for the discharge of its responsibilities under its six broad functions. The most significant activities specified are:

(a) the development of methods of chemical analysis and synthesis of materials and the investigation of the properties of rare substances;

(b) the study of methods of producing and of measuring high and low temperatures; and the behavior of materials at high and at low temperatures;

(c) the investigation of radiation, radioactive substances and x-rays, their uses and means of protection of persons from their harmful effects;

(d) the study of the atomic and molecular structure of the chemical elements, with particular reference to the characteristics of the spectra emitted, the use of spectral observations in determining chemical composition of materials and the relation of molecular structure to the practical usefulness of materials;

(e) the broadcasting of radio signals of standard frequency;

(f) the investigation of the conditions which affect the transmission of radio waves from their source to a receiver;

(g) the study of new technical processes and methods of fabrication of materials in which the Government has a special interest; also the study of methods of measurement and technical processes used in the manufacture of optical glass and pottery, brick, tile, terra cotta, and other clay products;

(h) the determination of properties of building materials and structural elements and encouragement of their standardization and most effective use, including investigation of fire-resisting properties of building materials and conditions under which they may be most efficiently used and the standardization of types of appliances for fire prevention;

(i) metallurgical research, including study of alloy steels and light metal alloys; investigation of foundry practice, casting, rolling and forging; prevention of corrosion of metals and alloys; behavior of bearing

metals; and development of standards for metals and sands;

(j) the operation of a laboratory of applied mathematics;

(k) the prosecution of such research in engineering, mathematics and the physical sciences as may be necessary to obtain basic data pertinent to the functions specified herein; and

(l) the compilation and publication of general scientific and technical data resulting from the performance of the functions specified herein or from other sources when such data are of importance to scientific or manufacturing interests or to the general public and are not available elsewhere, including demonstration of the results of the Bureau's work by exhibits or otherwise as may be deemed most effective.

In our examination of the Bureau, we have taken the six authorized broad functions with the related specific activities as the charter for the programs of the Bureau.

We believe that the Organic Act of 1901 with the amendments of 1950 gives the Bureau adequate authority for the establishment of programs that should fully meet the present national needs; therefore, we are making no recommendations for further legislation.

The Bureau has made requests for legislation dealing with problems of operation such as working capital funds. The Committee has not concerned itself in sufficient detail with operating procedures to have a view on these requests. Its comment on legislation is directed only to that which defines the scope of Bureau programs.

Importance of the Bureau of Standards to National Welfare

The functions authorized for the Bureau of Standards are of great importance to national welfare. As our society becomes increasingly industrialized, these functions assume even greater importance and the work of the Bureau in meeting the obligations of its assigned functions becomes more highly scientific, broader in scope and more complex in organization.

In a society whose welfare is so dependent on applied science and technology as is our own, it is most important that the Government carry out those functions in support of science and technology that are uniquely in its province in the most effective manner possible and that a sufficiently high level of effort be maintained to insure an adequate coverage of the area of responsibility. It has placed broad and important functions in this area with the Bureau.

The first four of the six functions of the Bureau are wide in scope and of great importance to our nation's industrial health. The remaining two, while more restricted in scope, are properly placed with the Bureau; for with its organization of experts in science and technology and their special technical facilities, it is fitting that the Bureau provide advisory service on scientific and technical matters to other Government agencies and, where uniquely indicated, to develop special devices to serve their needs.

It is the Committee's considered judgment that our highly industrialized society requires a Bureau of Standards that is the finest that can be created. To the extent that the Bureau is weak or inadequate, our technologic society is handicapping itself. By the very nature of its functions the Bureau's work must not be "reasonably good," it must be superior. It is not sufficient to have fairly good standards of measurement; fairly good methods of testing materials, mechanisms or structures; or reasonably good determination of important physical constants. The standards, the measurements, the test procedures must be the very best, the most accurate, the most reliable that can possibly be achieved at any given time, limited only by the state of the art at the time. It is thus more than a play on words to say that the "standards" by which the Bureau is judged must be the very highest and best.

The scope of coverage of the first four broad functions must be adequate to meet the needs of our advancing technology. Physical constants, the properties of new materials, the development of methods for their testing and their early incorporation in codes and specifications are vitally important to our highly industrialized society. The Bureau's work on the "new" should as a minimum keep step with the pace of applications of the "new" by industry. For its full effectiveness it must not lag.

It is with these views of the functions of the Bureau and of their importance to national welfare that the Committee has approached its assigned task of evaluation.

Place of the Bureau of Standards in the Government

The Committee has received suggestions from a variety of sources that the Committee consider the place of the Bureau of Standards within the organizations of Government. It has been suggested that the Bureau might better perform its authorized functions if transferred elsewhere in the Government from the Department of Commerce and specific suggestions have been given as to places more appropriate to its functions. The Committee has given thoughtful consideration to these suggestions. We are convinced that in the present framework of Government organizations there is no place better suited to the Bureau of Standards than in the Department of Commerce.

Evaluation and Comments

Organization. The Committee's appraisal is contained in the section titled Organization of the Bureau. The appraisal is generally favorable. The recommendations for modification at the Associate Director level should increase the effectiveness of scientific and technical administration and make it possible for the Director to give needed added attention to his broader administrative and professional responsibilities.

Personnel. The Bureau of Standards has high standing among the scientific and engineering people of our country and its superior qualities are recognized in

other countries. This results from the high quality of the professional staff, their dedication to the Bureau and the integrity of their scientific and engineering work.

While this favorable situation now prevails, it is deteriorating and unless corrective steps are taken, the Bureau will not be adequately staffed with men of high professional competence and standing in the years to come. Much of the strength described above comes from the professional staff recruited before World War II. The enlarged opportunities for scientists and engineers in our country since that time, the relation of supply to demand, the siphoning of junior personnel from the basic programs to the military programs and the contraction in basic programs since 1950 have all made contribution to the inadequacies in the junior professional staff. These are the men that will make up the core of the professional staff of tomorrow. Time marches on and the staff recruited before 1940 will through the years disappear from the Bureau.

The separation of the weaponry programs from the Bureau will help this situation. However, unless the decrease in support of the basic programs of the Bureau that began with the Korean incident and is continuing through Fiscal 1954 is reversed and to an adequate extent, the Committee views the future professional personnel outlook of the Bureau with grave concern. The expansion of the Bureau's basic program is treated in later sections.

Space and Facilities. The crowding of the laboratories for the basic programs necessitated by the rapid expansion of the defense effort was discussed in the section on Programs of the Bureau. While the transfer of weaponry programs to the Department of Defense will not immediately aid in the correction of this crowding, the Committee recommends that in the plans for the Department of Defense operation of this work provision be made for returning to the Bureau some of the space now occupied by weapons developments so that it can be used in the basic programs area.

The laboratory facilities for basic programs work are inadequate. There have not been funds sufficient for replacement of obsolete facilities and the procurement of new facilities to meet the needs of present-day laboratory work in science and technology. The contrast in the qualities and amount of facilities for military development, which are of high quality, modern and generous in amount, with that of facilities in many areas of the basic programs is most striking. This situation can only be corrected by the provision of increased funds for implementing the Bureau's basic work. There is urgent need for increased funds in the years immediately ahead. The Committee recommends that the Director of the Bureau, in cooperation with the advisory committees that will be later proposed, make a critical review of the Bureau's laboratory facilities requirements and that funds be requested promptly on completion of the study to bring the Bureau's technical facilities up to levels of quality and quantity that insure effective and efficient laboratory work.

Programs: General. The work of the non-ordnance divisions of the Bureau is described in some detail in Section II. In general, the quality of the work is good and the professional staff is competent. Comment here will be limited to general topics and to specific areas where emphasis is desired.

The extent of coverage in the basic programs is, in general, not adequate to meet present national needs. This is due to lack of personnel, space and modern technical facilities. During the postwar years, 1945–1950, encouraging progress was made in building the basic program work to a level commensurate with national needs. However, the Committee does not believe that the work level of 1950 had reached the minimum justified by the needs of the nation in science, technology and industry for the services rendered by the Bureau. The shrinkage in support of basic programs that began in 1950, occasioned by the nation's emphasis on building military strength, made it necessary to decrease the work level by almost 20% as measured by man years of effort by 1953 and the funds provided for Fiscal 1954 will make necessary a further reduction of at least 10%. The Committee recommends a reversal of this trend and a building back to the work level of 1950 at the earliest possible time. This could be accomplished with efficiency in a two-year interval, if funds were available.

The Director of the Bureau, his supervisory staff and the advisory committees to be referred to later should make a realistic and critical study of the minimum additional support, beyond the 1950 level, needed by the Bureau to bring its strength into balance with the nation's needs. The Committee is convinced that a level well beyond that of 1950 is required but believes the level should be arrived at by a more extended study than that of this Committee.

The Committee recommends that the basic program effort be increased to the level of 1950 in two successive increments in Fiscal Years 1955 and 1956; also that the Bureau and the proposed advisory committees be prepared, in time for consideration in the 1957 Budget requests, to recommend the amount of further expansion in basic programs that is required to meet the nation's needs.

The ordnance programs, because of their classified nature, are not treated in Section II. Since much of this work and its personnel will be transferred to the Department of Defense, an evaluation is not essential. However, as stated in the section concerning the Organization of the Bureau, selected members of the Committee with consultant aid, have looked at this work and have found it in good order.

Testing and Specifications: The "testing" area of the basic programs merits special attention. Quality control; calibration; acceptance, qualification, regulatory and referee testing; standard samples and product tests are included in this general classification. The funds for this area in Fiscal 1953 amount to some $2 600,000: $960,000 coming from direct appropriations to the Bureau and $1,700,000 in transferred funds from other agencies. Approximately $330,000

for standard samples and testing for the public was received by the Treasury as miscellaneous receipts and is not available to the Bureau.

This area might be considered as one of the important end products in the Bureau's basic programs. It is made up of so large a number of specific items that they have not received individual examination by the Committee. The Committee is concerned that a larger amount of repetitive testing is now done in the Bureau than is necessary with the present state of development of technology in industry. In addition to adequate testing of products under Government control that can be done by an industry in supplying its products to the Government, there are available competent commercial laboratories whose principal activity is in testing and evaluating products.

The Committee recommends that the repetitive test operations of the Bureau be critically examined by the Bureau and the proposed advisory committees. Some of this work may be eliminated by substituting Government supervised acceptance tests in the plants of the suppliers or by using commercial laboratories where it is appropriate. The Bureau may be handling acceptance testing for some agencies that was highly proper when initiated but under changing conditions the Bureau's services may no longer be required by the agency. In the review, consideration should be given to any such situations.

The personnel and facilities of the test program area of the Bureau should be primarily employed in the development of specifications and testing and quality control procedures. The Bureau should exert a leadership for the maintenance of high quality in the products of Government purchase with the minimum of participation in repetitive tests.

Evaluation of Commercial Products: The Bureau makes evaluation tests on the commercial products of industry from time to time at the request of other agencies of the Government and has done so, we believe, throughout its history. This is a service that the Bureau must render. It has a competence for product evaluation over a very large area of industrial products. Such competence does not exist to a comparable extent anywhere else within Government. This competence must be made available to other departments.

While the volume of this work is extremely small in relation to the Bureau's total basic programs, it is the area that most frequently brings the Bureau to the attention of the general public. The current "Battery Additive" evaluation is typical of others that have sporadically occurred throughout the Bureau's history where its findings have been challenged and wide public attention directed to them.

The Committee recommends that policy and procedures of a non-technical nature, particularly with other agencies of Government, for handling commercial product tests be reviewed by the Secretary of Commerce and appropriate members of his staff with the Director of the Bureau of Standards. The Committee recommends that the policy and establishment of the non-technical procedures on commercial product tests be the responsibility of the Secretary of Commerce. The policy on the technical content of the problem should reside with the Director of the Bureau. We believe that the area of commercial product tests involves policies and actions of a non-technical nature on which the Director of the Bureau should not be required to make the decisions.

Standard Samples: Since 1905 the Bureau has been the source of "Standard Samples" of technical products of industry, such as alloys, rubber compounds and more recently radioactive elements. These samples have been analyzed by the most modern methods and with greatest possible accuracy. They are mainly used for calibration of analytical chemistry procedures by industry and others. Frequently they serve as standards in refereeing questions between buyer and seller.

This is a proper function for the Bureau and one that within its resources it has performed well. With the restricted funds of recent years and the rising cost of preparing the standard samples, the Bureau has made no progress in increasing the number of kinds of samples. It has actually not been able to maintain its earlier position. Substantially no development for bringing into being new standard samples has been possible for some years. Increased funds for maintenance of present standard sample supply and for the development of new standard samples are urgently needed. There is a charge for the standard samples that is small compared to their worth and this money goes into the Treasury and is not available for Bureau use.

Radio Propagation: The cooperative relationships of Division 14—Central Radio Propagation Laboratory—with other agencies of Government should be specially commended. The demands for new assignments in the radio spectrum for communication and broadcast of intelligence purposes have increased greatly since the close of the war. The most effective use of the radio spectrum can only be realized with full knowledge of the propagation characteristics of each of its sectors. An interdepartmental Government committee was formed after the war, advisory to the Bureau on its propagation studies and the propagation research and evaluation programs of Government, so essential to the most effective allocations of regions of the spectrum to the various uses, were centered in the Bureau.

The plan is in national interest and its adoption is to be commended. The Bureau's propagation work has been excellent. However, we view with concern the change with time in composition of this committee. Assignments to the committee from the other agencies were initially from technical policy levels of the organizations of the agencies concerned with the use of radio spectrum. These assignments have been increasingly given to members of those organizations well below the policy levels. The Committee believes that the radio propagation programs are of such importance that the personnel of the advisory committee should be drawn from as high a level in the technical organizations of the agencies of Government as is com-

patible with the other responsibilities of these men. There are values in economy and effectiveness in the concentration of the propagation research and studies in one agency of Government. The Bureau of Standards is uniquely indicated as that agency.

This area of Bureau responsibility has been well supported through the 1950–1953 period of decreasing support in other basic program areas. This difference is most probably due to the large and direct interest of the military in radio propagation and to the fact that, in general, such work is of direct value to both military and civilian communications. While perhaps not so evident, many other areas of the basic programs into which the Bureau has not entered because of lack of funds also have direct values for the military and the civilian economy.

The Committee is impressed by the effectiveness of the propagation work and takes it as an indication of the values that may well be expected from other areas in which Bureau activities are indicated as required, if the Bureau is to meet the obligations of its authorized functions, when the Bureau is provided with funds necessary to the performance of the work.

Applied Mathematics: The Bureau's work in applied mathematics should be specially commended. While it is limited in scope, it has been most effective in its areas of activity. The Bureau was one of the early laboratories in digital computer work—theoretical and instrumental. Digital computers are of increasing importance to the military and to business and industry. A laboratory of today, with the science and technology scope of the Bureau, must have a competent mathematical staff. Such a project as the digital computer gives body and objectivity to the work of the staff. Much of their time, however, should be employed in consultation and aid to other programs.

Advisory Committee to the Director

The conversion of new scientific knowledge into industrial products is proceeding at an ever-increasing tempo. In the formation of the programs of the basic area of the Bureau, balanced attention should be given to the new areas of science and technology where standards activities will be required. To aid the Director in forming the new programs and in the consideration of balance on programs in being, the Committee believes that a more intimate tie with the science and technology of the country is desirable. It therefore recommends that the Director of the Bureau, with cooperation from the eight scientific and technical professional organizations that supplied the members of this Committee, form small advisory groups for the different scientific and technical areas of the Bureau. We believe it desirable for the members of these groups to be appointed by the societies as advisors to the Director. This Committee will discuss with the Director its views concerning the formation of these groups. Should he decide to form them, the Committee will recommend to the societies that they cooperate with the Director in the selection of suitable candidates from their memberships.

In making its recommendation for the advisory committees to the Director, the Committee has given consideration to the Visiting Committee of the Bureau of Standards that is appointed by the Secretary of Commerce under statutory authorization. It sees no conflict between the activities of the Secretary's Visiting Committee and the advisory committees to the Director of the Bureau that it is recommending. In fact, the detailed knowledge of the Bureau's programs that these advisory groups will acquire in the performance of their duties can be of use to the Secretary's Visiting Committee.

This Committee recognizes that in its studies it has reviewed items that in previous years have received attention from the Secretary's statutory Visiting Committee. In the reports of that Committee which have come to its attention, it has not found any observations or recommendations there that are inconsistent with those of this report.

The Committee is not making a record of its observations on specific inadequacies in personnel in supervisory and professional positions or of unsatisfactory relationships between different members of supervision and between supervision and professional staff. No large organization is completely free of individuals inadequate for their assignment or of frictions between members of the organization. In the close contact between Bureau personnel and members of the Committee and their consultants such inadequacies and frictions were found. Their amount is not excessive and the management of the Bureau is, in general, aware of their presence. In many cases constructive action for improvement is in progress and in others consideration is being given of "what to do" to bring about improvement.

Catalog of Recommendations

The recommendations of the Committee for improvement and strengthening of the Bureau have been given in previous sections. The more significant ones are listed here:

1. Higher level of activity in the basic programs.
2. Modernization of facilities and increased space for basic programs.
3. Improvement of organization at the Associate Director level.
4. Transfer of weaponry projects to the Department of Defense.
5. Continued use of the Bureau by Department of Defense and Atomic Energy Commission for nonweaponry science and technical aid.
6. Continued and increased use of the Bureau by other agencies of Government in indicated areas of science and technology.
7. Decrease in repetitive test operations at the Bureau.
8. Division of primary responsibility for policy and procedure on commercial product tests between the Secretary of Commerce and the Director of the Bureau.
9. Increased support of standard samples program.

10. Advisory groups to the Director selected from membership in eight scientific and technical societies.

Summary

From the Committee's extensive study of the Bureau's functions, its programs for discharging these functions, the facilities of the Bureau and its professional personnel, as well as from discussions with many scientists and engineers, it has reached some general conclusions. The major ones are listed:

1. The Bureau of Standards is of vital importance to national strength.

2. It is an organization with a splendid record and tradition, internationally recognized and respected.

3. It is, in general, staffed with professional men of competence, integrity and loyalty to the Bureau's functions and objectives.

4. With the increasing range and depth of technology, the need for the services of the Bureau of Standards becomes even more important and its functions more complex. The accurate determination of physical constants, the properties of materials, standards and standards practices and testing and evaluation procedures are all essential services for our industrial society.

5. Since the close of the war the technology of the nation has shot rapidly forward. The Bureau's basic programs expanded until 1950 but at a rate beneath that justified by the needs. Since 1950 the decrease in basic programs must be considered as tragic. The ground lost since 1950 should be regained in the next two fiscal years and the programs then expanded as detailed studies by the Director and his advisory committees find necessary.

6. Scientific and technical services to other agencies of Government are important responsibilities of the Bureau. In general, the Bureau has discharged these responsibilities well.

7. The Department of Defense and the Atomic Energy Commission have made broad and significant use of the Bureau. Their use of the Bureau in areas other than development of weapons is of value to the Bureau in its basic programs and should be encouraged.

8. The volume of weaponry development work has become large in comparison with all other activities of the Bureau. Its relative size and its effects on the other Bureau programs make its transfer from the Bureau desirable.

9. Other agencies of Government do not make as large use of the services of the Bureau as might well be expected. The Committee believes that an increase in the use of the Bureau by other agencies of Government should be encouraged.

10. If the recommendations of the Committee are followed, the Bureau should be in a positon to perform its authorized functions in balance at the minimum level for the nation's needs within a four-year period.

Excitatory Factors in Ventricular Tachycardia Resulting from Myocardial Ischemia. Potassium a Major Excitant[1]

A. Sidney Harris, Abdo Bisteni, Raymond A. Russell, John C. Brigham, and John E. Firestone[2]

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VENTRICULAR ECTOPIC ACTIVITY or the potentiality of ectopic activity following abrupt high ligation of the anterior descending artery of the dog occurs in three phases related to time elapsed since occlusion (*1, 2*). The first phase has a duration of about 10 min. During this period ectopic activity develops in almost all animals and precipitates ventricular fibrillation in 30–50% of them. In the animals in which ventricular fibrillation does not develop, ectopic activity passes through a maximum and declines to reach a level of only an occasional premature beat or ceases completely within 20 min or less after occlusion. First phase ectopic activity can be prevented by two-stage occlusion.

The second phase in the pattern of ectopic events is a period of little or no ectopic activity following the first phase, or following a two-stage occlusion bypass of the first phase. This period, during which there are only occasional ectopic complexes or none, has a duration as brief as 4.5 hr in some animals and as long as 7 or 8 hr in others, the majority being 5–6 hr.

The beginning of the third phase is indicated by the appearance of ectopic beats or a significant increase in their frequency if there were occasional ectopic complexes during the second phase. After the onset

[1] This investigation was supported in part by research grant H-1109(C1) from the National Heart Institute of the National Institutes of Health, U.S. Public Health Service, and in part by a grant from Eli Lilly and Co.

[2] Fellow of the Louisiana Heart Association.

of the third phase activity, the ectopic frequency increases rapidly during the next 3 or 4 hr, then more slowly. A high-frequency ventricular tachycardia results and persists 2–4 days. Myocardial necrosis begins about the time of the beginning of the third phase, that is, the delayed ventricular tachycardia.

Experiments that were directed toward discovery and identification of excitatory factors that develop in myocardial ischemia and infarction have eliminated, rendered improbable, or relegated to a position of minor importance, certain hypothetical excitants. They have also provided evidence of activity by others.

Excitation via sympathetic nerve impulses, reflexly or otherwise activated, has been shown by sympathectomy experiments to be of little or no importance to the ectopic events that develop in myocardial ischemia and infarction. The delayed ventricular tachycardia develops in dogs with upper thoracic sympathectomy just as it does in dogs with sympathetic nerves intact, and shows little difference in frequency and time course (*2*).

To test the possibility that histamine, liberated from ischemic tissue, might be an excitatory factor in these ventricular tachycardias, histamine phosphate was injected into coronary arteries of normal dogs in doses varying from those that produced very little effect upon blood pressure to those that produced a profound fall in pressure. No ectopic beats resulted. In other dogs with myocardial infarction ventricular tachycardia, Pyribenzamine was administered intravenously in increasing doses to test its effect upon the tachycardia. No diminution in ectopic frequency resulted although Pyribenzamine administration was continued until convulsions were produced. Histamine has been eliminated, therefore, from the list of hypothetical ectopic excitation factors.

The presence of sympathomimetic substances in heart muscle has been demonstrated by a number of authors (*3–7*). It appeared possible that such substances might be released in ischemia and infarction. The administration of sympathetic blockade or sympatholytic drugs, especially Regitine, has exhibited a significant degree of ectopic impulse suppressor effect in dogs with third phase ventricular tachycardia. The degree of ectopic impulse suppressor effect varies considerably in different animals, and in the same animal on successive days of the tachycardia. These effects of Regitine in the dog with ventricular tachycardia resulting from myocardial infarction can be interpreted, a priori, as meaning that sympathomimetic substances liberated from ischemic myocardium constitute an excitatory factor of varying significance in these animals. If this is true, it appears probable from the same experiments that some other excitatory factor with more constant and predictable effect also exists. Regitine does not fully eliminate ectopic activity in any case, even when infused into the occluded coronary artery distal to the ligation. It must be remembered too that sympathetic blockade agents have other effects than specific antagonism to the action of sympathomimetic compounds, and that the ectopic impulse suppression exhibited might occur via some other mechanism (*8*).

Tissue extracts have been made from infarcted and noninfarcted myocardium from dogs and injected into coronary arteries to test for ectopic excitatory effect. These extracts produced ectopic beats and periods of ventricular tachycardia. In some trials the main ectopic activity resulting from the injection has a long latent period, as long as 10–20 min, and ectopic beats at low frequency may continue much longer. These results indicate clearly that some excitant with properties differing from those of epinephrine was present in the extract. Potassium was considered a possibility.

Potassium chloride solutions in varying concentrations were injected into coronary arteries of dogs without myocardial ischemia. Ventricular ectopic beats, ventricular tachycardia, and ventricular fibrillation were produced in different trials; the latency and intensity of the ectopic events depended upon the amount of potassium chloride injected. Analyses of some of the myocardial extracts that had produced ectopic activity demonstrated potassium concentrations equal to the potassium concentrations of some of the active KCl solutions. The experimental data to be presented are concerned with the problem of excitation by potassium: potassium that is liberated from the ischemic and autolyzing myocardium and potassium that is injected into coronary arteries.

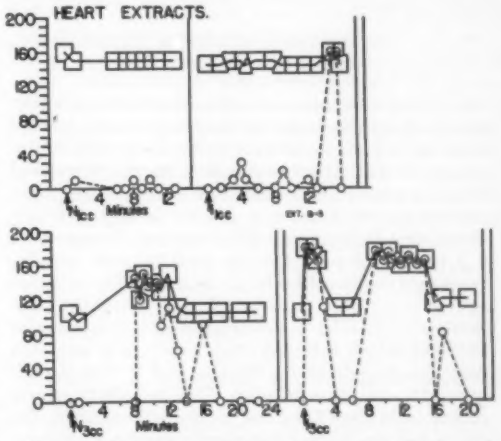

FIG. 1. Ectopic excitatory effects of injections of myocardial extracts. Arrows, times of injections; N, extract of normal tissue; I, extract of 24-hr infarct tissue; ordinates, beats/min; circles, ventricular ectopic rate; squares, total heart rate.

Figure 1 shows some of the results of injections of myocardial extracts prepared according to a method of von Euler (*9*). In the experiment illustrated in the upper chart, injection of 1 cc of extract from normal myocardium (each cubic centimeter prepared from 2 g tissue) produced a scattering of ectopic beats lasting about 10 min. In the second trial illustrated, 1 cc of

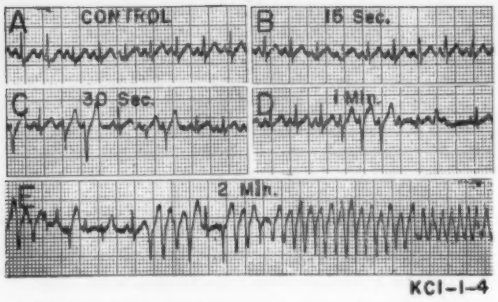

FIG. 2. Electrocardiograms: effect of injection of KCl, 2.8 mg/kg into the anterior descending artery.

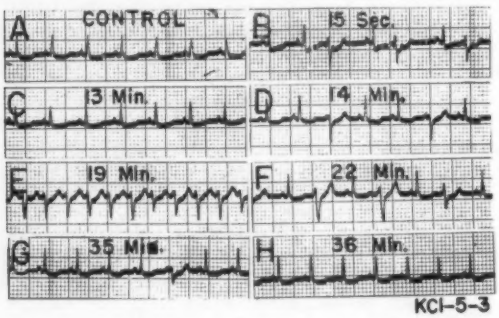

FIG. 3. Electrocardiograms: effect of injection of KCl, 1.15 mg/kg into the anterior descending artery.

extract from the infarcted region also produced a scattering of ectopic beats up to about 13 min, when a brief period of ventricular tachycardia with a frequency of 160/min was recorded. In the experiment 3 cc of extract from normal tissue produced no ectopic activity for the first 8 min. After a latency of 8 min, ventricular tachycardia with a maximal frequency of 150/min developed. Ectopic activity with varying frequency continued up to the 16th min. The injection of 3 cc of infarct extract to this dog produced an immediate ventricular tachycardia with a frequency of 180/min, which subsided after 3 or 4 min and then reappeared again at the 8th min and continued until about 17 min after injection. The immediate ectopic effects could have been due to sympathomimetic substance but the delayed tachycardia could not. Following some intracoronary injections of heart extracts, the ectopic activity continued in the form of occasional ectopic beats until approximately 40 min after injection. The differences in effects shown are random variations. No consistent difference was found between extracts from normal myocardium and those from 24-hr infarcts.

Results of injections of potassium chloride into the anterior descending artery are shown (Figs. 2 and 3). In Fig. 2, following the control electrocardiogram, KCl, 2.8 mg/kg in 5 cc of the dog's own blood was injected. This was a large dose. No ectopic activity is seen in the 15-sec record, but abnormal complexes are present in the 30-sec and 1-min segments. The 2-min record shows ventricular tachycardia accelerating into ventricular fibrillation. In Fig. 3, the control record was followed by intracoronary KCl, 1.15 mg/kg in 5 cc of blood, a much smaller dose. Little ectopic activity is shown until the 19th min when paroxysmal ventricular tachycardia with a frequency of 280 supervened. After the paroxysm, low frequency ectopic beats were recorded until the 35th min. The chart (Fig. 4) shows

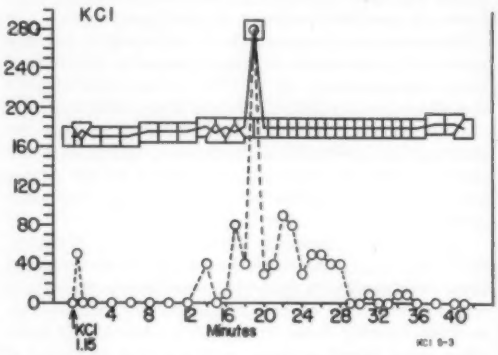

FIG. 4. Chart: experiment from which Fig. 3 was taken.

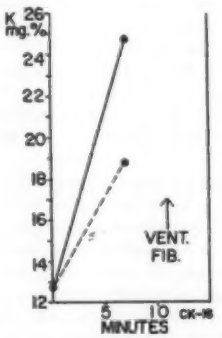

FIG. 5. Large increase in potassium concentration in blood plasma from coronary veins draining ischemic muscle and lesser increase in blood from vein in normal area during ventricular tachycardia preceding ventricular fibrillation.

the entire course of ectopic events recorded in the experiment from which the electrocardiograms in Fig. 3 were taken. The paroxysm was not sudden in onset and offset but showed a crescendo-decrescendo pattern lasting about 16 min.

Evidence of release of potassium in ischemic myocardium was obtained by determination of potassium concentration in plasma of venous blood drawn from the coronary veins draining the ischemic area following coronary occlusion. Figure 5 (solid line) shows a large increase in potassium content of venous blood from the ischemic area following abrupt occlusion of

the anterior descending artery. This blood sample was taken 7 min after occlusion, while ventricular tachycardia existed. The concentration rose from the control level of 12.75 mg% to 24.5. The ectopic activity continued and grew faster, culminating in ventricular fibrillation 4 min after the sample was drawn, or 11 min after occlusion. Determination of potassium in venous blood from a vein from the posterior surface of the ventricle (dotted line) shows a rise in potassium concentration about one-half as great as that in the vein in contact with the area of ischemia. This indicates that the venous drainage is mixed and that the liberation of potassium in ischemic heart muscle is greater than the quantities that are shown by analysis of blood from veins from the ischemic area alone, although these veins receive the greater concentration of excess potassium.

Figure 6 shows potassium concentrations in plasma from the ischemic region in an experiment with long duration. A pattern of variations that is characteristic of all 6 occlusion experiments of long duration with coronary venous plasma determinations is illustrated. The potassium concentration rose during the first few minutes of occlusion, fell off again, and then began a greater rise which reached its maximum on the first postocclusion day (22 hr determination). After passing through this maximum, the concentration declined again. In some experiments the potassium concentration has returned to the control level on the second or third postocclusion day. In the experiment shown, some elevation remained at the time of the last observation, 117 hr after occlusion. In other experiments, with determinations at different intervals than those in the experiment illustrated, the increase in potassium has shown a marked acceleration at about 4–5 hr after occlusion. The potassium concentrations show an encouraging positive correlation with the phases of ectopic activity. The first postocclusion day has always been the period of fastest ectopic ventricular complexes and the time when the tachycardia was most difficult to control with drugs.

Determination of potassium concentration in tissue, from the infarct and from normal myocardium on the fifth postoperative day in the dog from which the data (Fig. 6) were obtained, showed a loss of four-fifths of the potassium from the infarct.

It appears that sympathomimetic substances in necrotizing heart tissue may be an excitatory factor of some importance, but this conclusion is supported only by experiments with sympathetic blockade drugs.

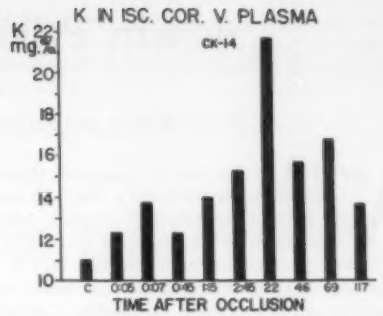

FIG. 6. Changes in potassium concentration in blood plasma from coronary veins draining ischemic (infarcted) area at selected times during 5 days of coronary occlusion.

Therefore, the participation of sympathomimetic substance in excitation during ischemia and infarction is regarded as probable, but not demonstrated.

Potassium, liberated in the ischemic muscle, however, is the factor upon which definite evidences from a variety of experiments converge in an unequivocal manner. Potassium injected into a coronary artery of a dog with continuing circulation produces ectopic activity. Ischemia of ventricular myocardium liberates potassium in sufficient quantities to significantly elevate potassium concentration in coronary venous blood from the ischemic area. A positive correlation exists between the periods of major elevation of potassium concentration in these samples and periods of most intense ectopic ventricular activity. The potassium concentration in these samples reapproaches control levels at times that correspond approximately to the times of disappearance of ectopic activity in infarction. Potassium content of infarcted muscle is greatly reduced at that time. The evidence for locally liberated potassium as an excitatory agent is very strong.

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Edwin P. Hubble: 1889–1953

I. S. Bowen

Mount Wilson and Palomar Observatories, Pasadena, California

AMERICA has lost one of its most distinguished astronomers in the sudden death September 28, 1953, of Dr. Edwin P. Hubble. After the completion of his education at Oxford University and the University of Chicago and a brief term of service as an officer in the U.S. Army during World War I, Dr. Hubble joined the staff of the Mount Wilson Observatory in 1919. Within ten years after his arrival at this observatory he had revolutionized the concepts of astronomers as to the size and content of the universe.

Before 1920 astronomical measurements of distance had been limited to objects in the Milky Way system, and the universe was believed to consist essentially of this one great system of stars, having a diameter of about 100,000 light years. With the aid of the newly constructed 100-in. telescope, Hubble was able to resolve a representative group of spiral nebulae into stars and to identify some of these stars in terms of known stellar types. By comparing the apparent brightness of these stars with their previously determined absolute brightness he obtained an approximate measurement of the distance of the objects in which they were found. These distances at once indicated that these nebulae have dimensions and total luminosities similar to our own Milky Way system. From these and further studies by Hubble it became evident that the universe consists not of a single stellar system such as the Milky Way but of some hundreds of millions of such systems extending at least out to the extreme range of the largest telescopes, a billion or more light years away.

In succeeding years Hubble and the department which he built carried out extensive studies of the distances, luminosities, masses, structures, and motions of these stellar systems which he named extragalactic nebulae. From spectroscopic observations it was shown that the nebulae are receding from us with velocities proportional to their distances; this leads to the concept of an expanding universe. These studies, many of which required the full power of the 100-in. telescope, emphasized the need of still greater telescopes and provided one of the chief reasons for the construction of the 200-in. Hale telescope on Palomar Mountain. Hubble assisted greatly in the design of this instrument and made the first observations with it. Since the start of the joint operations of the Mount Wilson and Palomar Observatories he served on the Observatory Committee and played a major role in planning the programs to be carried out by these observatories.

The very fundamental discoveries made by Dr. Hubble brought him many high honors. He was the recipient of numerous honorary degrees and other awards. He was a member of the National Academy of Sciences and the American Philosophical Society, and a foreign member of the Royal Astronomical Society, the Vienna Academy, and the French Academy of Sciences. For defense work in World War II he received the Medal for Merit.

Dr. Hubble's interests extended far beyond his own field of cosmology. As a student he had first trained for a career in law and had specialized in Roman law while a Rhodes scholar. He was admitted to the bar in Kentucky and practiced there for a short time before taking up his astronomical studies. He always retained a great interest in historical subjects and especially those related to the history of science. His competence and interest in the field of history was recognized by his election to the Board of Trustees of the Huntington Library.

News and Notes

Third International Biometric Conference

THE THIRD INTERNATIONAL BIOMETRIC CONFERENCE convened at the Hotel Grande Bretagne, Bellagio, Italy, Sept. 1, 1953, under the sponsorship of the International Biometric Society, an organization of individual members which forms a section of the International Union of Biological Sciences. The Conference was welcomed to Italy by C. Barigozzi and A. Buzzati-Traverso, after which G. Darmois of the University of Paris delivered his presidential address on "Dignités nouvelles de la Statistique dans la Recherche." The morning session continued with a symposium on the First Course in Biometry under the chairmanship of W. G. Cochran, with papers by L. Martin, G. Barbensi, C. I. Bliss, and A. Vessereau, and concluded with a business meeting. The afternoon program on Mathematical Problems in Genetics was chaired by A. Buzzati-Traverso and addressed by Sir Ronald Fisher, K. Mather, D. Lowry, and J. L. Lush.

The morning session on Sept. 2 concerned Methodological Problems in Biometry with G. M. Cox in the chair and papers by J. W. Hopkins, F. Anscombe, W. G. Cochran, M. Keuls, and M. J. R. Healy. Biometry in Immunology was the subject of the after-

noon session with J. Ipsen both serving as chairman and giving a paper, the other speakers were R. Prigge, L. B. Holt, and S. Peto. In the evening, exhibits on various biometrical subjects were presented by E. Morice, E. Olbrich, S. C. Pearce and G. H. Freeman, J. M. Tanner, and J. Dufrenoy and F. M. Goyan.

On Sept. 3 the morning session considered Biometric Methods in Agriculture, with P. V. Sukhatme presiding and papers given by F. Yates, V. G. Panse, T. N. Hoblyn and S. C. Pearce, and G. Rasch. In the afternoon, motor boats took members of the Conference and guests for an excursion on Lake Como, ending at Villa d'Este in Cernobbio for tea and returning about dusk. In the evening the Azienda Autonoma di Soggiorno di Bellagio entertained at a reception and dance at the Lido di Bellagio.

The program on Sept. 4 opened with papers on Functional Relations in Experimentation, with H. Wold as chairman and D. J. Finney and J. Berkson as speakers, and continued with a second session on Mathematical Problems in Genetics, F. Yates presiding over papers by A. R. G. Owen and C. A. B. Smith. A noon business meeting on the Society journal *Biometrics* was chaired by editor G. M. Cox and considered editorial policy and procedure. The afternoon was devoted to contributed papers by A. F. Parker-Rhodes, D. W. Gooddall, G. Karreman, M. Frechet, and G. Teissier, under the chairmanship of M. J. R. Healy. That evening the Conference enjoyed a banquet at the Grand Hotel Villa Serbelloni.

In the morning of Sept. 5 the program concerned Industrial Applications of Biometry, with A. Linder presiding, and papers by E. A. G. Knowles, D. R. Read, and H. C. Hamaker. The closing business session heard and approved a report by the Committee on the Teaching of Biometry presented by its chairman, W. G. Cochran. It then adopted a series of resolutions, of which several expressed the appreciation of the Conference for the arrangements which made the occasion so enjoyable, especially the splendid work of Luigi Cavalli-Sforza and his colleagues on the Organizing Committee. In another resolution the Conference noted the great importance of biometric method in the design of biological investigations, both pure and applied, and in the analysis of their results. In view of the social and economic importance of research in applied biology, governments and universities were urged to establish integrated instruction in biometry which would cover both the statistical and mathematical aspects of pure and applied biology. Following a discussion of tentative plans for an International Biometric Symposium in 1955 and a fourth International Biometric Conference in 1958, the Conference adjourned.

Registration showed 125 participants, including 101 members of the Biometric Society and 12 official delegates. The United Kingdom was represented by the largest national group (27 registrants), followed by Italy and the U.S.A. (16 each), France (13), the Netherlands (11), Germany (8), and 18 other countries each with 4 or fewer participants. The general proceedings of the Conference will appear in the December issue of *Biometrics*, and many of the papers presented during the meeting will be published in the same journal through 1954.

C. I. Bliss

Cambridge University
Department of Genetics
Cambridge, England

The 28th Session of the International Statistical Institute

The twenty-eighth session of the International Statistical Institute was held in Rome, Italy, Sept. 6–12, 1953. This section was also the fourth biennial postwar meeting of this organization, following the meetings that were held in the United States in 1947, Switzerland in 1949, and India in 1951. The Institute is the world's leading professional organization in the field of statistics. All the important international, national, and regional statistical societies are affiliated with the International Statistical Institute.

The agenda of the 28th session of the ISI covered the following topics: (1) application of statistics to the study of productivity problems in industry; (2) regional cooperation in statistics; (3) training in statistics; (4) general methodology and mathematical statistics; (5) population statistics; (6) agricultural statistics; (7) economic statistics; (8) industrial application of statistics; (9) social and cultural statistics.

About 180 scientific papers covering these fields were presented. In addition to delegates from various countries, delegates from various international and national statistical organizations were present. It is believed that this meeting was one of the best attended since the first session of the ISI, which was held in Rome in 1887. Over 400 persons registered for the session.

The meetings were held in the modern FAO Building, which has excellent facilities for scientific meetings that include the use of simultaneous translation equipment. The preparation by the Italian Government was of the highest quality. Some outstanding events were an address by the Prime Minister of Italy, a reception by Luigi Einaudi, President of Italy and a member of ISI, and an audience with His Holiness, Pope Pius XII who then spoke upon the role of statistics in modern society.

Stuart Rice of the U.S. was elected an honorary president of the ISI after having served as president for three terms. George Darmois of the University of Paris was elected president for the next two-year term. The next meeting of the Institute will be held in Rio de Janeiro in 1955.

Americans attending the conference were as follows: Stuart A. Rice, Charles A. Bicking, Joseph F. Cunningham, Calvert L. Dedrick, W. Edward Deming, Grover W. Ensley, W. Duane Evans, Frank R. Garfield, William R. Pabst, Jr., Samuel Weiss, F. Bernstein, C. I. Bliss, Grant I. Butterbaugh, W. G.

Cochran, M. A. Copeland, Gertrude Cox, Besse B. Day, Louis I. Dublin, John Durand, Milton Gilbert, Margaret Gurney, Robert C. Hamer, Harold Hotelling and Mrs. Hotelling, Simon Kuznets, William R. Leonard, Frank Lorimer, Oskar Morgenstern, Karl Pribram and Mrs. Pribram, Charles F. Roos, Hans Staehle, P. K. Whelpton, and Robert W. Woodbury.

SAMUEL WEISS

American Statistical Association
Washington, D. C.

Paul D. Foote and E. A. Eckhardt Retire

Paul D. Foote, vice president of the Gulf Oil Corporation and the Gulf Refining Company and executive vice president and director of the Gulf Research & Development Company, retired from active executive work on Dec. 31. Dr. Foote received the B.A. degree from Western Reserve University, the M.A. degree from the University of Nebraska, and the Ph.D. degree in physics from the University of Minnesota. From 1911 to 1916 he was associated with the National Bureau of Standards. As chief of the Pyrometry Section, he pioneered in the development of methods for temperature measurements and control in engineering and industrial processes. In 1916 he became assistant manager of the Fisher Scientific Company, where he shared in the invention of the F & F optical pyrometer and other temperature measuring equipment. He rejoined the Bureau of Standards in 1918, and in 1921 was appointed chief of the Sections on Radium, X-rays, and Atomic Structure. His initiation of the standardization of x-ray dosage for therapeutic treatment and for the protection of x-ray operators and patients led to the standard codes of practice in use today. In 1926, at the request of Secretary of Commerce Herbert Hoover, Dr. Foote undertook a special mission to Europe to report on engineering and medical developments in x-ray and radioactivity. Most of the radium in America at that time was measured and certified under Dr. Foote's direction, and it was he who handled a gift of radium to his friend Madame Curie.

He joined the Gulf organization in 1927 as senior fellow of the Gulf Fellowship at the Mellon Institute of Industrial Research in Pittsburgh, and during the next two years organized a coordinated program of research dealing with the production and transportation of petroleum. In 1933, the Gulf Research and Development Company was established with Dr. Foote as its executive vice president and director of research. He was elected a vice president of the Gulf Oil Corporation and the Gulf Refining Company in 1945. During both World Wars, he rendered valuable service to the United States Government. In World War I he engaged in various military technical projects, the most important of which was the organization and direction of the development of heat-controlled processes for the manufacture of high-grade optical glass. During World War II he was a consultant to the Office of Scientific Research & Development and a member of the Executive Committee for Anti-Submarine Warfare. Later he became a member of the Industrial Advisory Group of the Atomic Energy Commission and at present is a member of the Advisory Committee to Army Ordnance.

Dr. Foote organized and for many years edited the *Review of Scientific Instruments* and was also editor-in-chief of the *Journal of the Optical Society of America*. He is a past president of the American Physical Society, past vice president of the Washington Academy of Sciences, and past secretary of the Optical Society of America. He is coauthor of *Origin of Spectra* and of *Pyrometric Practice*, and author of more than 150 technical articles in the fields of radiation, atomic structure, capillarity, pyrometry, and petroleum technology. In 1951 he was awarded the Outstanding Achievement Gold Medal of the University of Minnesota, and in 1953 the honorary degree of Doctor of Science by the Carnegie Institute of Technology.

E. A. Eckhardt, vice president and associate director of research, Gulf Research & Development Company, retired from active service on Dec. 31. Dr. Eckhardt was a pioneer in geophysical prospecting for petroleum. As early as 1920, in a colloquium at the U.S. Geological Survey, he gave a talk on geophysical prospecting, probably the first of its kind in America. He received his education at the University of Pennsylvania, where he was awarded a B.S. degree in 1908 and a Ph.D. in 1912, both in the field of physics. From 1912 to 1913, as Harrison Research Fellow, he studied at the University of Göttingen, after which he returned to the University of Pennsylvania as assistant professor of physics, a post he held for four years. For the next eight years he was associated with the National Bureau of Standards. During this time, he proposed, built, and installed the first radio-acoustic ranging equipment for the U.S. Coast and Geodetic Survey, a system which, although greatly improved in detail, remains basically the same today. He also developed for the Survey a radio time recorder that greatly facilitated gravity measurements; devised methods and equipment for the accurate determination of the speed of sound in sea water; and contributed significantly to the foundamental knowledge of the acoustics of rooms, particularly auditoriums.

In 1928, after several years of effort toward the development of new and better geophysical techniques, Dr. Eckhardt joined the Research Department of the Gulf Production Company, in Pittsburgh, as staff geophysicist and later became assistant research director. He transferred to the Gulf Research & Development Company as assistant director when that Company was organized in 1933. He was elected vice president of Gulf Research in 1941, vice president of the Dominion Gulf Company (a Canadian subsidiary) in 1947, and was named associate director of Gulf Research in 1952.

Dr. Eckhardt contributed to the development of several significant war devices through military research at the Bureau of Standards during World War I, and for the National Defense Research Committee

during World War II. He has for some time been a lecturer in petroleum engineering in the Graduate Work in Industry Program of the University of Pittsburgh. Most recently he has been engaged in the application of geophysical techniques to prospecting from deposits of solid minerals. He is a past president and recently an honorary life member of the Society of Exploration Geophysicists; and past president of the Terrestrial Magnetism and Electricity Section of the American Geophysical Union.

Because of the retirements of Dr. Foote and Dr. Eckhardt, **Blaine B. Wescott** has been appointed director of research of the Gulf Research & Development Company, effective Jan. 1, and **Leo J. Peters** and **Jerry McAfee** have been named associate directors of research. Dr. Wescott also has been elected executive vice president of Gulf Research and a member of its Board of Directors. Dr. Peters and Dr. McAfee have been elected vice presidents of that company. All three men are veteran employees of the Gulf Companies.

Science News

An article in the January issue of *Cancer Research* leads the way to a greater understanding of **cell growth.** Nine new substances have been announced, after years of research at the McArdle Memorial Laboratory, University of Wisconsin Medical School, by a team working under Van R. Potter, professor of oncology. The present advances were made by Hanns Schmitz, on leave from the Cancer Research Institute of Heidelberg University, Germany, and R. B. Hulbert, who is now on leave to study at the Karolinska Institute, Stockholm, Sweden. The substances are guanosine monophosphate (GMP), guanosine diphosphate (GDP), guanosine triphosphate (GTP), cytidine monophosphate (CMP), cytidine diphosphate (CDP), cytidine triphosphate (CTP), uridine monophosphate (UMP), uridine diphosphate (UDP), and uridine triphosphate (UTP). Discovery of these nine building blocks in animal tissues brings to 12 the number of materials of this type known to be used by the body in growth processes.

A new synthesis that affords a potentially inexpensive and plentiful supply of **hydrocortisone** was reported at the Sixth Annual Scientific Conference of the American Chemical Society's North Jersey Section. The paper, by Eugene P. Oliveto, Corinne Gerold, and E. B. Hershberg of the natural products research department of the Schering Corporation, Bloomfield, describes a unique step in the transformation of ox bile into hydrocortisone.

Formic acid is used in the new process to yield a formate of the delicate steroid compound that is obtained from the ox bile or, more recently, from fermentation processes. This formate then goes through later steps in the synthesis without destruction of the complicated molecular structure that makes the compound active against disease.

A result of two years of research, the formate step was described as a "protective device for the sensitive hydroxyl group at position 11" in the molecular configuration. The advantage of the new synthesis is that the protective formate can later be removed by a chemical reaction that releases the hydrocortisone.

Clouds as a possible untapped water resource in the arid Southwest will be studied intensively in a research program operated jointly by the University of Arizona and the University of Chicago. Establishment in the next few months of an **Institute of Atmospheric Physics** at the University of Arizona at Tucson, initially manned by University of Chicago scientists, is aimed at determining how much the future development of dry regions throughout the world can be enhanced by efforts to stimulate additional precipitation. The new institute will be financed partly by state funds and partly from private funds, chiefly those provided by the Sloan Foundation and by other sources. A group of prominent citizens headed by Lewis W. Douglas, native Arizonan and former United States ambassador to Great Britain, developed the plans for the Institute and promoted its financing.

A team of scientists working in the field of cloud physics under the leadership of Horace R. Byers, chairman of the Department of Meteorology at the University of Chicago, will organize and carry out the research work. This group has been engaged in research on clouds and thunderstorms for several years, and is making fundamental laboratory studies and field measurements in cooperation with the Air Force. Roscoe R. Braham, Jr., associated with Dr. Byers on the University of Chicago Cloud Physics Project, will have a joint appointment between the two universities to direct the Arizona research. He will be assisted by others from the University of Chicago research group, who will receive direct appointments at the University of Arizona or joint appointments between the two institutions. Dr. Byers will devote part of his time to the Arizona activities, and Mr. Douglas, whose interest has guided the formation of the institute, will continue to serve as administrative consultant.

The **National Science Board** of the National Science Foundation has passed the following resolution:

> The National Science Foundation is ready to cooperate with other agencies of the Federal Government in carrying out the ideas expressed by President Eisenhower in his address, Atomic Power for Peace, given before the General Assembly of the United Nations, Dec. 8, 1953.

A new, strong **radio star** has been discovered in the constellation of Gemini, according to a report by J. E. Baldwin and D. W. Dewhirst of Cambridge University, England, in the Jan. 23 issue of *Nature*. Such stars emit energy in the form of radio waves that are picked up on earth by radio telescopes. For this find Drs. Baldwin and Dewhirst used a new telescope, rigged up as an interferometer.

The new radio star's shape and structure is strikingly similar to a large double-loop system in the constellation of Cygnus. Because of this similarity, the

investigators suggest a search for radio waves from these loops in Cygnus, a summer constellation now disappearing from view. Observations were made at a wavelength of 3.7 m.

Scientists in the News

Hannes Alfvén, professor and director of the Laboratory of Electronics at the Royal Institute of Technology in Stockholm, Sweden, is a visiting professor during 1953–54 in the Physics Department and in the Institute for Fluid Dynamics and Applied Mathematics at the University of Maryland. Dr. Alfvén is a recognized astrophysicist, known especially as the founder of magneto-hydrodynamics and as an authority on sun spots and other problems of cosmic electrodynamics.

Wendell Holmes Camp, of the University of Pennsylvania faculty and one of the quinine hunters during World War II, has been named professor of botany and head of the department at the University of Connecticut, effective Feb. 1. He succeeds **Richard A. Howard,** who will become Arnold Professor and director of the Arnold Arboretum at Harvard University.

Alvin E. Cormeny, of Haddonfield, N.J., an industrialist, has assumed office as the eighth president of the Worcester Polytechnic Institute.

Announcement has been made of the retirement of **Leonard Harrison Cretcher** as a director of research at the Mellon Institute of Industrial Research, with which he has been prominently connected since 1922. Dr. Cretcher has distinguished himself as an organic chemist, especially by his many original contributions to the literature and by his fundamental participation in the chemotherapy of pneumonia and malaria.

Dr. Cretcher was educated at the University of Michigan and Yale University. He served as an instructor at the University of Tennessee in 1913–14, as a fellow of the Rockefeller Institute for Medical Research, 1916–18, and as a research chemist for the National Aniline Chemical Co., 1919–22. He then joined Mellon Institute as a senior fellow, in 1926 was appointed head of the Institute's Department of Research in Organic Chemistry, in 1931 was made an assistant director of the Institute, and 20 years later was named a director of research. During World War I Dr. Cretcher was a captain in the Chemical Warfare Service. He is a member of the Board of Editors of the *Journal of Organic Chemistry* and received the Pittsburgh Award of the American Chemical Society in 1944.

At its annual banquet Feb. 19 The Theobald Smith Society, New Jersey Branch of the Society of American Bacteriologists, will confer the first Selman A. Waksman Lectureship Award on **Bernard D. Davis** of the Tuberculosis Research Laboratory, Public Health Service, New York, for his contributions to microbiology through his studies on the biochemical genetics of microorganisms. The title of Dr. Davis' lecture will be, "Mutants as Metabolic Cartographers." The award, to be conferred annually on a scientist under 40 for outstanding contribution to microbiology, comprises a lectureship with an honorarium of $100.00 and an engraved medal.

Raymond A. Erickson, formerly chief process engineer with the Great Lakes Carbon Company, Chicago, is the new supervisor of chemical engineering at the Armour Research Foundation of the Illinois Institute of Technology.

Louis A. Gottschalk, for three years a research psychiatrist for the Clinical Center of the National Institute for Mental Health, Department of Health, Education, and Welfare, Washington, D.C., is now associate professor of psychiatry at the University of Cincinnati College of Medicine.

Regina Flannery Herzfeld has succeeded the **Rev. Dr. Cornelius J. Connolly,** who retired, as head of the Department of Anthropology at Catholic University of America. Dr. Herzfeld is the first woman to head a department in the University's graduate school of arts and sciences.

At Union University, Jackson, Tenn., **Hillard Jones,** has been made head of the Chemistry Department, and **Willard L. Henning,** an associate professor of biology.

Ross A. McFarland, associate professor of industrial hygiene at the Harvard School of Public Health received one of the 1953 Flight Safety Foundation awards for his recently published book, *Human Factors in Air Transportation.* Others who received awards were **M. G. Beard,** vice president for engineering, American Airlines, for his work on cockpit standardization; and **I. Irving Pinkel** and his associates at the National Advisory Committee for Aeronautics' Lewis Flight Propulsion Laboratory in Cleveland, Ohio, for their studies of aircraft fire protection.

Owing to an error in a news release sent to *Science,* **W. C. Steere** of the Biological Sciences Department at Stanford University was reported as having accepted an invitation to serve as president of the Eighth International Botanical Congress to be held in Paris in July; actually, he will be president of the Bryological Section of the Congress.

Alfred P. von Auersperg, formerly assistant pathologist at the Binghamton City Hospital and Kilmer Memorial Laboratory, Binghamton, N.Y., has been appointed senior pathologist at the Central Islip State Hospital, Central Islip, L.I., N.Y.

Niles Yngve Wessell, professor of psychology at Tufts College, has recently been installed as the eighth president of the college.

G. W. Wharton, formerly of Duke University, is now professor and head of the Department of Zoology at the University of Maryland.

Education

The new Science Hall at **Bridgewater College** was dedicated last June, and the laboratories and classrooms provided have been in use since that time. The building, which houses the departments of biology, chemistry, physics, mathematics, psychology, and also some of the social sciences, was constructed and equipped at a cost of $450,000. It is the first unit in the college's ten-year expansion movement.

The U.S. Atomic Energy Commission has approved the allocation of fissionable material as fuel for a nuclear reactor to be built by **Pennsylvania State University.** The low-power "swimming pool" type reactor will be operated for nuclear research and for the training of students. It is the second privately owned reactor for which the AEC has authorized the use of nuclear fuel. The first, built by the Consolidated University of North Carolina, began operation last Sept. 5. The Pennsylvania reactor will be constructed and housed on the campus for an estimated $250,000 to $300,000. The cost of construction and operation will be borne by the university, without financial assistance from the AEC. The reactor will operate at a power level of 100 kw. It will be cooled and moderated with ordinary water, and will use enriched uranium fuel. The fuel elements will be suspended in a pool of water sufficiently deep to serve as a shield against the radiation produced by the reactor. A similar "swimming pool" facility, the Bulk Shielding Test Reactor, has been in operation at Oak Ridge National Laboratory since 1952. Experience has demonstrated that this type of reactor is inexpensive, safe to operate, and easy to maintain.

The reactor project is under the technical direction of William M. Breazeale, professor of electrical engineering. Dr. Breazeale formerly was on the staff of the AEC'S Oak Ridge National Laboratory, and was project engineer for the Bulk Shielding Test Reactor at Oak Ridge. The School of Engineering at the university will administer the reactor project, but the reactor also will be utilized for research of interest to the School of Mineral Industries, the School of Chemistry, and the School of Agriculture.

The **Polish Academy of Sciences** has announced the establishment of four research institutes whose chief function is to achieve greater coordination of scientific work now being conducted on a national scale. The new Institute of Basic Technical Problems will carry on long-range investigations of special importance to the country's economy, while the Institute of Physics will work on solid bodies and in nuclear and theoretical physics. The Institute of Geography will lay the foundations for a proper distribution of production forces; one of its objectives is to map Poland's farm lands to aid in determining the kind of plants and livestock best suited to a given region.

The Institute of the History of Material Culture, in addition to planning and coordinating research, will devote itself to Polish archaeology, general archaeology, the history of Polish medieval and modern material culture, and ethnography. As part of the nationwide effort to increase agricultural production, the Academy will this year also set up institutes of plant genetics, plant physiology, and livestock biology.

During the past year the **University of Maryland** has completed a million-dollar physics laboratory and an extensive physics-mathematics-engineering library. A laboratory for molecular physics, to be directed by A. M. J. F. Michels, is now under construction and will be completed early next year.

New research programs are being conducted in cosmic rays, microwave physics, and in solid state and elementary particle theory; established projects in gaseous electronics, fluid dynamics, and statistical mechanics are being continued. Graduate assistantships in teaching or research are available, paying $1200 minimum plus tuition for the academic year.

Kaven Hall, $600,000 structure at **Worcester Polytechnic Institute,** will house the civil engineering department in the spring. Construction was begun in October, 1952. The building will have four classrooms, three drafting rooms, a library, lecture hall for 100 students, four laboratories, offices for faculty, and conference rooms. With its occupancy, all branches of engineering will be departmentalized in their own buildings on the WPI campus. Moses B. Kaven, to whom it is a memorial, was a vice president of United Shoe Machinery Co., and a trustee and benefactor of the college.

Grants and Fellowships

Establishment of an annual award of $1000 for "outstanding contribution to nuclear isotopic applications in the field of chemistry" has been announced by the American Chemical Society, which will administer the prize. The award, to be known as the **ACS Award for Nuclear Applications in Chemistry,** is sponsored by the Nuclear Instrument & Chemical Corporation of Chicago and is open to scientists of any age or nationality who apply radioactive forms of chemical elements and compounds in chemical work.

Nominations are now being solicited for initial presentation in 1955 for this award and also for a second new prize to be administered by the Society, the **Beckman Award in Chemical Instrumentation.** The Beckman Award, which consists of $1000 and a certificate, has been established by Beckman Instruments, Inc., of South Pasadena, Calif., to "recognize and encourage outstanding achievement in the development of new instruments for chemical analysis and in the application of analytical instruments for chemical process measurement and control." Candi-

dates must be residents of the United States or Canada.

Nominations for both the Nuclear Chemistry and Beckman awards must be submitted before June 1 to R. M. Warren, asst. sec. of the American Chemical Society, 1155 16th St. NW, Washington 6, D.C.

Bryn Mawr College has announced that the following fellowships and scholarships are available for the year 1954–55 to graduate students in the fields of science:

Resident fellowships, $1700 each, in biology, chemistry, geology, and physics, open to women who have completed one year of graduate work.

Scholarships and fellowships, from $1000 to $1700, offered to men and women for work in biochemistry, biophysics, chemical physics, geochemistry, geophysics, and psychophysics, under the plan for the Coordination of the Sciences.

The Lillia Babbit Hyde Foundation scholarship of $1400, offered to a first-year woman for work in biology, chemistry, or physics.

A postdoctoral fellowship in physics or chemistry with a maximum stipend of $3200 open to a candidate who holds a doctor's degree, the holder to be known as the Helen Schaffer Huff Memorial Research Fellow.

The College also offers several demonstratorships of $1,350 each to both men and women. Demonstrators give half-time to laboratory teaching in undergraduate courses and half-time to graduate study. Information regarding the entire fellowship program is available from the Graduate Office of the College. *Applications are due Mar. 1.*

The **National Foundation for Infantile Paralysis** announces a limited number of postdoctoral clinical fellowships in physical medicine and rehabilitation for candidates who wish to become eligible for certification in that field. Fellowships will cover a period of one to three years in training centers that have been approved for residencies in physical medicine and rehabilitation. Stipends are based on the individual need of each applicant. Appropriations of $475,000 in March of Dimes funds have been made to cover the cost of the program. Eligibility requirements include United States citizenship, graduation from an approved school of medicine, completion of at least a one-year internship in an approved hospital, and a license to practice medicine in at least one state. The age limit is 40. Selection of candidates will be made on a competitive basis by a clinical Fellowship Committee composed of leaders in the fields of medicine and professional education.

In addition to these full-term fellowships, the National Foundation has available a number of short-term fellowships to physicians who wish to become better acquainted with physical medicine and rehabilitation as it relates to their particular specialties. The candidate, in addition to meeting the other requirements, must have completed at least one year of residency in orthopedics, pediatrics, neurology or internal medicine. The period of training will be from three months to one year at a center that emphasizes physical medicine in relation to the applicant's specialty. For these fellowships the National Foundation has provided a special appropriation of $51,050.

The National Foundation also has a limited number of fellowships available to psychiatrists who are interested in the emotional problems of the physically disabled, particularly of the poliomyelitis patient with respiratory paralysis. Eligibility requirements include two years of graduate training in psychiatry acceptable to the American Board of Psychiatry and Neurology. Financial benefits are based on individual needs. Appointments will be made for one year, subject to renewal. The programs of the Fellows should be undertaken in a center concerned with rehabilitation of the physically disabled, which has affiliations with an approved Department of Psychiatry. An opportunity for working with poliomyelitis patients with respiratory difficulties should be available. The Department of Psychiatry is to be responsible for supervision and training of the Fellows.

Information concerning qualifications and applications for all three types of fellowships may be obtained from the Division of Professional Education, National Foundation for Infantile Paralysis, 120 Broadway, New York 5.

The establishment of a three-year $15,000 fellowship for postdoctorate training in the science of nutrition has been announced today by **The National Vitamin Foundation,** 15 E. 58 St., New York 22. The fellowship, one of the first of its type in the field of nutrition, will be known as the **Russell M. Wilder Fellowship,** in honor of the recently retired Director of the National Institute of Arthritis and Metabolic Diseases of the National Institutes of Health. The fellowship will be given to a candidate holding a doctorate in medicine or one of the biological sciences.

Meetings and Elections

The 16 sections of the AAAS have elected the following members-at-large to serve four-year terms beginning in January, 1954: A-Mathematics—J. W. Tukey, Princeton University; B-Physics—Raymond J. Seeger, National Science Foundation; C-Chemistry—J. C. Lewis, Western Regional Research Laboratory, Albany, California; D-Astronomy—Guillermo Haro, Observatorio Astronomico, Mexico; E-Geology and Geography—Joe W. Peoples, Wesleyan University; F-Zoological Sciences—T. L. Jahn, U.C.L.A.; G-Botanical Sciences—R. H. Wetmore, Harvard University; H-Anthropology—Loren C. Eiseley, University of Pennsylvania, and Hallam L. Movius, Jr., Peabody Museum, Harvard University (to replace W. W. Howells, 1955); I-Psychology—J. C. R. Licklider, M. I. T.; K-Social and Economic Sciences—J. J. Spengler, Duke University; L-History and Philosophy of Science—C. West Churchman, Case Institute of Technology; M-Engineering—Carl F. Kayan, Columbia University; N-Medical Sciences—Jacob Furth,

Children's Cancer Research Foundation, Boston; O-Agriculture—K. S. Quisenberry, U.S.D.A.; Q-Education—George G. Mallinson, Western Michigan College of Education.

The **American Association of Physical Anthropologists** will hold its annual meeting, Mar. 26–28, at the Fels Research Institute, Antioch College, Yellow Springs, Ohio. For information address J. Lawrence Angel, The Jefferson Medical College, 307 S. 11 St., Philadelphia 7, Pa.

The latest progress in jet engine fuels, recent developments in synthetic detergents, and chemical advances against the diseases of farm animals will be reported at the 125th national meeting of the **American Chemical Society,** which will be held in Kansas City, Mo., Mar. 24 through Apr. 1. Important improvements in silicone paints, current trends in the manufacture and use of pesticides, and the status of chlorophyll also will be discussed in some of the 697 papers to be presented. Research achievements in petroleum chemistry, the patentability of new uses for chemical compounds under recent patent law changes, and improved techniques in the teaching of chemistry are among the many subjects scheduled for consideration by 5000 chemists and chemical engineers, who will come from all parts of the country, as well as Hawaii and Puerto Rico.

Leonard V. Sorg of the Standard Oil Company (Ind.), Sugar Creek, Mo., is general chairman of the meeting. Registration will open Mar. 23 in the Municipal Auditorium, which will also be the site of most of the technical sessions sponsored by 19 scientific and technical divisions of the Society. A highlight of the conclave will be a general meeting on Saturday, Mar. 27, in the Hotel Muehlebach, where nine $1000 awards will be presented to outstanding chemists and chemical engineers and the 1954 Garvan Medal will be conferred upon a distinguished woman chemist. In addition, 28 members who have served the Society for 50 consecutive years will receive certificates. The meeting will be in two parts so that some of the Society's Divisions will meet during the first week, from Mar. 24 through Mar. 27, and the rest will meet Mar. 29 through Apr. 1.

The **19th Cold Spring Harbor Symposium on Quantitative Biology** will be held June 7–14 on the general topic, "The Mammalian Fetus—Physiological Aspects of Development." The primary function of the symposium will be to evaluate the principal morphological, physiological, and biochemical factors that are essential for the immediate well-being and future development of the mammalian embryo. This will involve a consideration of hereditary-fetal and maternal-fetal relationships, as well as of the development and function of the membranes, decidua, and trophoblast of the conceptus. Attention will be focused on the homeostatic factors that contribute to normal somatic and visceral development of the embryo to meet the requirements of living before, during, and just after birth. Twenty-four of the participants will come from European countries, including Belgium, Finland, France, Great Britain, Ireland, Netherlands, Norway, Sweden, and Switzerland. The symposium is being sponsored by the Carnegie Corporation of New York, the National Science Foundation, and the Association for the Aid of Crippled Children. For program and information, address the Biological Laboratory, Cold Spring Harbor, N.Y.

The annual meeting of the **Radiation Research Society** will take place in Cleveland, Ohio, on May 17–19. The sessions will be held at the Wade Park Manor Hotel and at Western Reserve University. In addition to submitted papers, there will be a symposium on "The Role of Nuclear Damage in Radiation Induced Cell Injury and Death" and also several invited papers in radiation physics and chemistry. Those desiring to report original research in radiation effects, or who wish additional information, should communicate with the secretary of the Society, Dr. A. Edelmann, Brookhaven National Laboratory, Upton, Long Island, N.Y.

Miscellaneous

The first issue of the new quarterly publication of the Association of Southeastern Biologists, the **A.S.B. Bulletin,** will appear in March. Victor A. Greulach, professor of botany at the University of North Carolina, is editor. Present plans do not call for the inclusion of any research papers, but short papers may be added in the future.

Friends of the late Sir Jack Drummond plan to endow a **Drummond Research Fellowship** in nutrition. The following committee on this side of the Atlantic has joined together to formulate an appeal for contributions to the memorial: Charles H. Best, R. Keith Cannan, Hans T. Clarke, A. S. Cook, Vincent du Vigneaud, E. C. Kendall, C. G. King, Karl E. Mason, L. A. Maynard, L. B. Pett, Wm. H. Sebrell, Jr., Elmer L. Sevringhaus, M. L. Tainter, and John B. Youmans. Checks may be made payable to the Drummond Memorial Fund and forwarded to Prof. L. A. Maynard, Cornell University, Ithaca, N.Y.

The AAAS has acceded to the requests of a number of libraries for preparation of a **Microcard edition of *Science,*** and the 1953 issues are now available in that form. The bother and expense of binding are completely eliminated, and the great saving in space will be a consideration of critical importance to many subscribers. The 1953 Microcard edition consists of 71 cards that together measure less than 1 in. in height. Thus it may be estimated that the Microcard editions of *Science* for 25 years could be put into the same amount of space as that occupied by the bound volumes for a single year.

The cost of the Microcard edition for 1953 has been set at $15.00. Single or standing orders may be placed with the AAAS.

Technical Papers

Electron Microscopic Study of Spermatozoa

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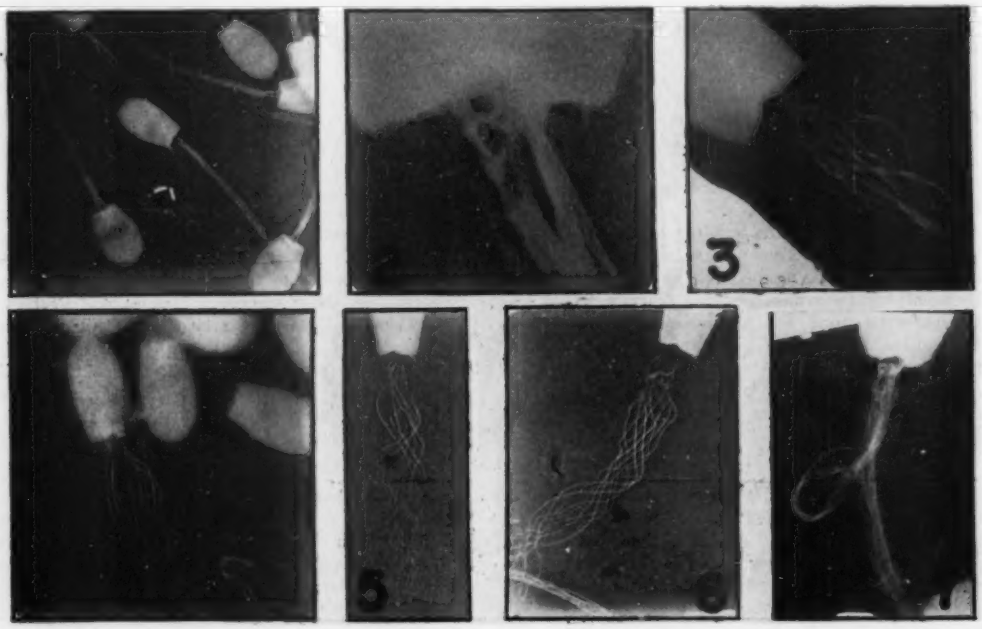
The problems of interest in sperm morphology are chiefly the head components, the filaments and fibrils that constitute the axial fiber, and the "brush effect" at the end of the sperm tail. No attempt will be made here to review the work of previous investigators (*1–15*). This report presents electron micrographs that may, it is thought, bring about a clearer conception of the fibrils near the head-neck junction of ram spermatozoa than those previously published, and it introduces NaOH as an effective reagent for denuding the spermatozoa for morphological investigations.

The semen specimen was clarified by washing with 33% alcohol, and centrifuging; it was washed and centrifuged again, and then filtered. The spermatozoa left on the filter paper were suspended in distilled water (1 to 2 million spermatozoa/ml). To reveal the fibrils of the spermatozoa, the membranes that surround the fibrils were removed by adding various amounts of NaOH solution to tubes containing the sperm suspension and were kept at 5° C for 12 to 72 hr. At the end of the treatment the NaOH was removed by centrifugation and the spermatozoa were again suspended in distilled water. They were then shadowed with chromium at an angle of 20° to the horizontal and observed with an RCA Model EMU-2D electron microscope.

The results obtained in the electron micrographs show that spermatozoa can be denuded by suitable concentrations of NaOH. The degree of disintegration of the sperm cells can be adjusted by varying the concentration of the reagent and the length of the reaction time. The electron micrographs provide evidence to substantiate the observations of Randall and Fried-

[1] For the electron microscopy we are indebted to James F. Carpenter, Electron Microscopist, Dept. of Physics, Oregon State College.



FIGS. 1–6. Ram spermatozoa treated with various concentrations of NaOH for 68 hr at 5° C. *1*, in 0.025 *N* NaOH, showing disintegrated membrane and loose fibrils in the neck, midpiece, and tail region (×1980); *2*, in 0.025 *N* NaOH, showing partially denuded neck region, fibrils within the surrounding helix are clearly visible (×16,800); *3*, in 0.15 *N* NaOH, showing denuded spermatozoa with 9 fibrils clearly visible up to the neck region; and a group of the fibrils near the neck region still remaining in the surrounding helix (×7800); *4*, in 0.15 *N* NaOH, showing further denuded spermatozoa with 9 fibrils clearly visible up to the neck region (×3600); *5* and *6*, in 0.15 *N* NaOH, showing denuded spermatozoa with 9 fibrils clearly visible (×3600).

FIG. 7. Rabbit spermatozoa treated with 0.045 *N* NaOH for 12 hr at 5° C showing partially denuded spermatozoa with fibrils visible through the remaining membrane (×4800).

laender in that the axial fibrils of ram spermatozoa are continuous from the head through the neck to the midpiece. In addition, the micrographs show clearly that there are 9 fibrils up to the head-neck junction in ram spermatozoa. The axial filaments that constitute these fibrils and the microstructure of spermatozoa from other species are under investigation. Detailed results will be reported later.

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Manuscript received November 27, 1953.

A Fungistatic Substance Extracted from Vitrain

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In 1951 W. D. Evans (*1, 2*) reported the presence of a bacteriostatic substance in vitrain in English coals. He named it vitricin because of its occurrence in the vitrainous parts of coal seams. He demonstrated that it inhibited *Bacillus subtilis* and attributed differences in prevalence of pneumoconiosis among mine workers to differences in the amount of vitrain coal in different mines: the higher the percentage of vitrain coal in a mine, the lower the incidence of pneumoconiosis among the miners.

Vitrains from southern and northern Illinois and Wyoming coals were examined by a chromatograph technic similar to that used by Evans. The coal from northern Illinois was No. 2 coal, C rank, from Kankakee County, that from southern Illinois was No. 6 coal, B rank, from Franklin County, and that from Wyoming was a Hanna Basin coal. The examination of these coals revealed that all of them contained soluble material fungistatic in nature (Table 1). Subsequently R. M. Kosanke (*3*) of the Illinois State Geological Survey modified Evans's extraction technic in several ways and extracts obtained by these methods were tested for their fungistatic capacities. The method

TABLE 1. Inhibition of *Endoconidiophora fagacearum* by extracts of vitrains. Measurements represent the maximum widths and lengths of the areas of inhibition around the extract-treated filter paper strips.

Origin of coal	Clear area measurements	
	Width (mm)	Length (mm)
Illinois Coal—Franklin County	11	58
Illinois Coal—Kankakee County	6	20
Wyoming Coal—Hanna Basin	17	76

used in obtaining the extract reported on below is briefly as follows. Vitrain, after being ground into particles of small size, is washed several times with a mixture of equal parts of acetone and methanol. The liquid resulting from this elution is then poured into a Coors porcelain evaporating dish. A sheet of Whatman No. 1 filter paper $2\frac{1}{4} \times 5\frac{1}{2}$ in. is suspended so that about $\frac{1}{2}$ in. of the paper is submerged in the liquid. The liquid is absorbed by the filter paper and, as the solvents evaporate from the filter paper, a chromatograph is produced that has several distinct bands of light and dark brown.

Two such chromatographs developed from Hanna Basin vitrain coal of Wyoming were tested against eight fungi: *Aspergillus niger, A. terreus, Myrothecium verrucaria, Glomerella cingulata, Colletotrichum trifolii, Verticillium albo-atrum, Endoconidiophora fagacearum,* and *Ceratostomella ulmi. A. niger, A. terreus,* and *M. verrucaria* are saprophytes. *G. cingulata* causes bitter rot of apples; *C. trifolii,* anthracnose of clover. The remaining three are vascular parasites of plants; *E. fagacearum* and *C. ulmi* being highly virulent pathogens respectively of oak and elm, *V. albo-atrum* a destructive pathogen of various trees, shrubs, and herbs.

To test the potency of the material deposited in the chromatograph the following procedure was used. Eight milliliters of potato dextrose agar, pH 5.6, were poured into a sterile Petri dish. After the agar had solidified, the surface was thinly flooded with a suspension of spores obtained from young cultures grown on test tube slants of potato dextrose agar, pH 5.6, at 25° C. A strip $2\frac{1}{4}$ in. wide was cut from the top of the chromatograph, as it contained none of the fungistatic material, and the remainder, $3\frac{1}{4}$ in. long, was cut vertically into strips 3/16 in. wide. After allowing sufficient time for the water of the spore suspension to be absorbed by the agar, a strip chosen at random was placed on the surface of the agar. The Petri dish was then incubated at 25° C and observed at intervals. The test for each fungus was run in triplicate.

That the extract in the chromatograph inhibited spore germination was shown by the maintenance on either side of the chromatograph strip of clear areas into which the fungistatic material had diffused in sufficient amount to prevent germination of the spores. The diagrams, Fig. 1, show the patterns of inhibition

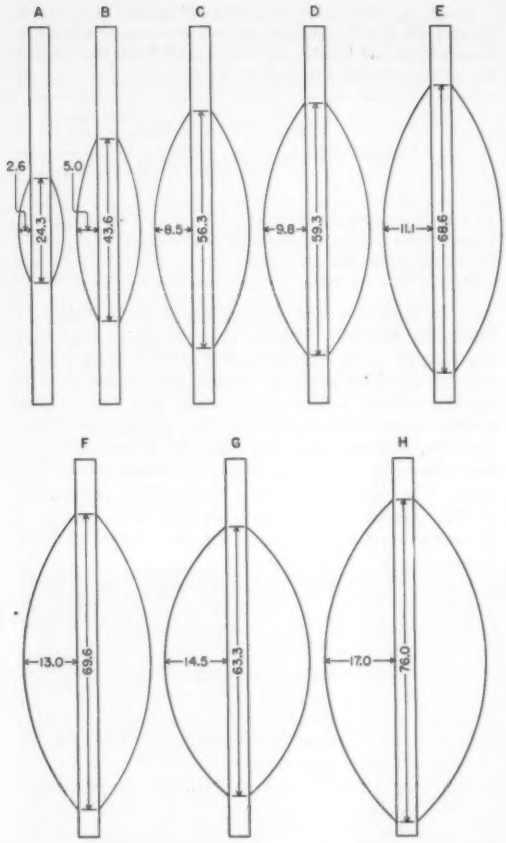

FIG. 1. Diagrams of the average maximum zones of inhibition around extract-impregnated filter paper (from Wyoming coal—Hanna Basin). A. *A. niger* in 24 hours; B. *A. terreus* in 24 hours; C. *M. verrucaria* in 33 hours; D. *V. albo-atrum* in 43 hours; E. *G. cingulata* in 33 hours; F. *C. ulmi* in 33 hours; G. *C. trifolii* in 43 hours; H. *E. fagacearum* in 74 hours.

for the eight fungi. The measurements are the averages of the widths and lengths of three replications when inhibition was at a maximum. *A. niger* was inhibited least, *E. fagacearum* most. Inhibition of the other fungi lay between these extremes. The greatest width of inhibition usually occurred about 27 mm above the part of the chromatograph that had been submerged. At this point there was a band in the chromatograph which appeared translucent when placed in front of a light.

Because of differences among the test fungi in time required for spore germination and in rate of growth of hyphae, different lengths of time, for example, 24 hr for *A. niger*, 74 hr for *E. fagacearum*, were required for the maximum, or first, area of inhibition to become defined. Such differences no doubt influenced the size of the regions of inhibition, as the slower fungi would afford opportunity for wider diffusion of the fungistatic material. Once established, however, the inhibition area usually remained constant for 12 or more hours, after which invasion from the outer margin occurred, *A. niger* advancing 1 mm, *A. terreus* 21 mm, in 54 hr.

The effect of the extract was fungicidal on *E. fagacearum* and *C. trifolii*, but fungistatic on the other six fungi. This difference in effect may have been due, also, to the rate of spore germination, as the spores of *E. fagacearum* and *C. trifolii* required longer periods for germination and were therefore exposed longer to the extract than were the spores of the other fungi.

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Manuscript received November 9, 1953.

A Bacteriostatic Substance Extracted from the Vitrain Ingredient of Coal[1]

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Illinois State Geological Survey, Urbana

A substance obtained from vitrain (bright bands in banded coal) can prevent the growth of *Bacillus subtilis*, as reported by Evans (*1, 2*). He termed this substance vitricin. To extract the substance, Evans covered finely ground vitrain with methanol. Strips of Whatman No. 1 filter paper were suspended about ½ in. into the mixture of methanol and coal, and the active material, vitricin, was carried along with the solvent in this modified ascending paper chromatograph method.

A bacteriostatic substance has been extracted from American coals using the method proposed by Evans and by other methods and with other solvents. This substance has been extracted (see Figs. 1, 2) from lignite, subbituminous coal, and high volatile bituminous coal of C, B, and A rank (classification of coal according to the degree of metamorphism from lignite to anthracite). The bacteriostatic action of extracts from high volatile A rank coal is slight, and entirely absent from one sample of the Buck Mountain anthracite. It would seem, therefore, that either the substance is absent or it cannot be extracted from higher rank coal, at least with present methods.

A substance extracted from a Pleistocene wood and two modern woods prevents the growth of *B. subtilis*. Whether this substance is the same as that obtained from coal is not known.

Initially, Evans' method was employed for the extraction of the substance from vitrain of Illinois Herrin (No. 6) coal. A bacteriostatic substance was adsorbed on paper strips, as shown in Fig. 1D. The

[1] Published with permission of the Chief, Illinois State Geological Survey, Urbana.

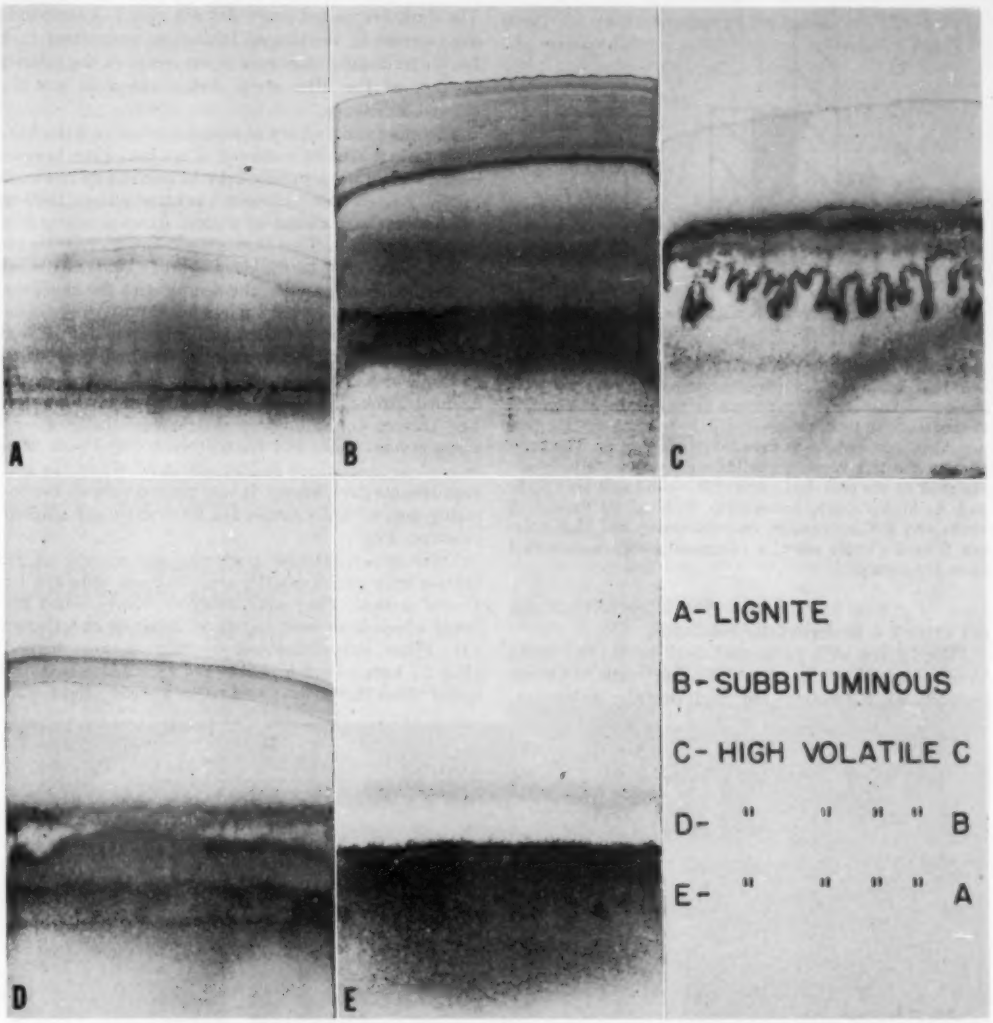

FIG. 1. Strips of filter paper 2¼ in. wide containing substance extracted from vitrain by the simple evaporation method. Methanol was used as the solvent. The filter strips are arranged according to the rank of the coal from which the vitrain was obtained.

uppermost lines were light brown and extended for 7 mm. Below this region was a tan zone and a darker brown zone; at the bottom of the strip were deposited fine particles of coal. These filter strips were cut into segments 3/16 in. wide and placed on the surface of nutrient agar (pH 7.3) previously inoculated with *B. subtilis* and incubated at 25° C.[2] Tests were conducted in triplicate plates. A clear area or zone of inhibition occurred in all three Petri dishes and was measured at 24 hr. The maximum clear area of the first tests was 4.5 mm wide and 60 mm in length. In some later experiments, measurements of the zone of inhibition were also made at 48 and 72 hr. In many of these the zone of inhibition was about 1 mm narrower and 1–2 mm shorter after 72 hr.

Besides methanol some other solvents were tested: acetone, absolute ethanol, benzol, pyridine, amyl alcohol, butyl acetate, and ether. With all these solvents, the filter paper adsorbed a coloration. Acetone extracts gave results comparable with those of methanol, absolute ethanol somewhat less, and amyl alcohol only a

[2] The author wishes to express his appreciation to Norman C. Schenck and J. C. Carter of the Illinois State Natural History Survey for determination of the potency of the bacteriostatic substance obtained from vitrain.

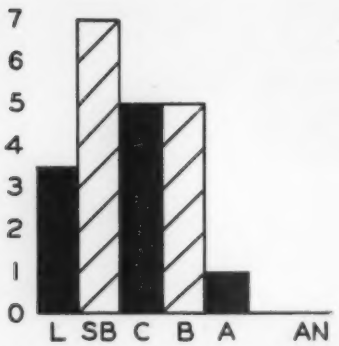

FIG. 2. Average width of inhibition on either side of a 3/16-in. strip of filter paper containing a bacteriostatic substance extracted by methanol from vitrain. The simple evaporation method was used and *B. subtilis* was the test organism. Measurements were taken after 24 hr. The numbers to the left represent millimeters, the letters denote the rank of the coal. L, lignite; SB, subbituminous; C, B, and A, high volatile bituminous coals of C, B, and A rank; and AN, anthracite. Subbituminous and high volatile B rank vitrain samples (diagonal lines) were tested most frequently.

trace of a zone of inhibition. The other solvents did not extract a bacteriostatic substance.

Filter strips with prominent dark brown-red zones were obtained while experimenting with different methods of extracting the bacteriostatic substance. The dark brown-red zones did not give a corresponding increase in the size of inhibition, suggesting that the bacteriostatic substance is contained in the colored portion of the filter strip, but perhaps is not the colored substance.

The most satisfactory equipment to extract the bacteriostatic substance consisted of a pyrex glass sample container with a capillary tube at one end of the container. This sample container was attached to a 1000-cc vacuum flask by means of a cork. Air was allowed to enter the vacuum flask through a 4-mm glass tube inserted in the cork of the flask. Glass wool was placed in the container between the sample and the capillary tube to screen out vitrain particles.

A finely ground sample of vitrain weighing 41.5 g was placed in the container and covered with a solvent (acetone or half acetone and half methanol) which was drained through the sample with the aid of a vacuum. The solvent containing the extracted substance was rerun several times and fresh solvent added each time to replace that which had evaporated. When the solvent became dark brown, it was poured into an evaporating dish with the suspended filter strip and allowed to evaporate.

These latter extracts prevented the growth of *B. subtilis* only slightly better than extracts obtained by Evans' method. They were, however, vastly better for fungi which have been tested by Schenck and Carter (*3*). Filter strips obtained by this vacuum method (Fig. 3) have a dark brown to red zone which is translucent when the strip is viewed in a strong light, and

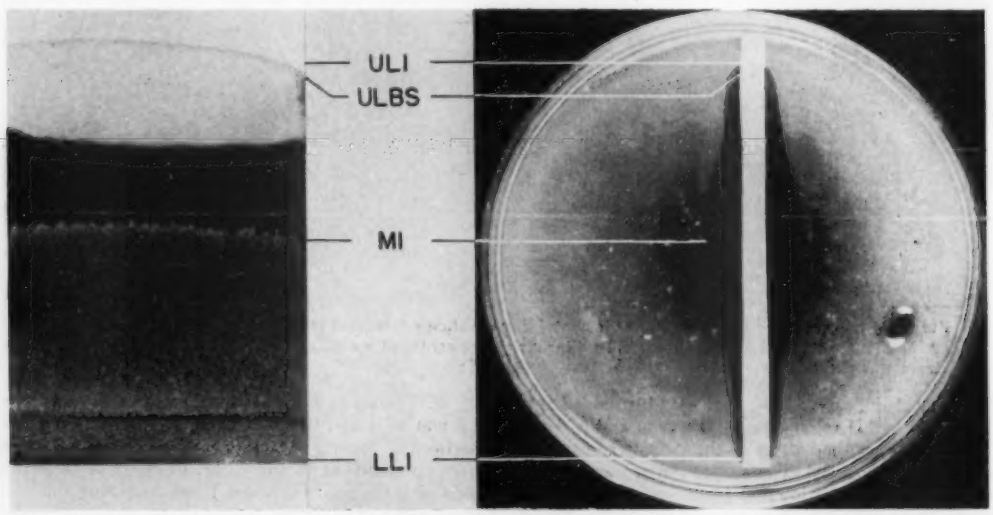

FIG. 3. Left, a strip of filter paper containing a bacteriostatic substance from vitrain from a coal of subbituminous rank by the vacuum method of extraction with acetone, and right, a portion of this same filter paper in a Petri dish containing a culture of *B. subtilis* in nutrient agar. Symbols are: ULI, upper limit of inhibition; ULBS, upper limit of extracted bacteriostatic substance; MI, maximum zone of inhibition; and LLI, lower limit of inhibition. The maximum zone of inhibition was 6.5 mm in width and 79 mm in length. The zone of inhibition appears black, and the active culture gray. The dark band to the left was 15 to 20 mm wide and was translucent when viewed in a strong light.

fewer upper lines of deposition (compare Fig. 3 and Fig. 1B). The maximum inhibition for *B. subtilis* occurs in the region of the translucent zone.

To concentrate the bacteriostatic substance still further, the extract was placed in a beaker so that the evaporation area was less and the evaporation slower than in a dish. This method of evaporation produced a longer zone of translucency on the filter strips and increased the zone of inhibition.

When the solvent and extracted substance were evaporated to about 20 cc, a milky-tan precipitate and a dark brown-red substance were produced. Evaporation filter strips of each showed that the milky-tan substance contributed to the upper lines of the previous strips, whereas the dark brown-red substance formed the translucent zones. Both of these strips proved to contain a bacteriostatic substance.

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Manuscript received November 9, 1953.

The Growth Regulating Properties of Some β-Naphthylalanines[1, 2, 3]

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The growth regulating activity of *dl*-α-alanine and β-indolylalanine (*1*) and β-alanine (*2*) has been reported. Since tryptophane (β-indolylalanine) is a precursor to 3-indoleacetic acid in plants (*3*), it was of interest to study the effect of substituting naphthyl radicals for the indolyl group in tryptophane. Several naphthyl derivatives of alanine were studied and found to have unusual growth regulating properties.

The relative activity of the β-naphthylalanines as possible growth regulators was determined by employing a biological test. Alamercery (*1*) has demonstrated that cucumber seeds during germination are very sensitive to 3-indoleacetic acid, the inhibition of root growth being proportional to the concentration of 3-indoleacetic acid used. Accordingly, cucumber seeds of the variety Marketer were germinated on filter paper in Petri dishes. The seeds were first grown on filter paper impregnated with 0.05 *M* KH_2PO_4 buffer solutions for 24 hr and then treated with the desired chemicals to a concentration of 100 ppm. Ten seeds were placed in each dish and each treatment was replicated three times. The temperature of the containers was kept at 25° C and observations were made at the end of 120 hr for growth and abnormal development. The length of the main root of the seedling was used as an index of plant response (Table 1).

Table 1. The effect of various β-naphthylalanines upon the root growth and the respiratory quotient of germinating cucumber seeds.

Compound*	Root length in mm after 5 days	µl O_2/100 mg of tissue/hr†	µl CO_2/100 mg of tissue/hr†	RQ
Control	83.0	36.4	31.0	0.852
1-Naphthaleneacetic acid	2.0	26.4	33.7	1.278
β-1-Naphthylalanine	9.0	44.1	41.7	0.945
Glycyl-β-1-naphthylalanine	14.0	39.6	37.4	0.945
β-3-Thianaphthylalanine	15.0	49.6	50.4	1.013
Carbobenzoxyglycyl-β-1-naphthylalanine	44.0	34.7	29.5	0.850
Carbobenzoxyglycyl-β-2-naphthylalanine	42.0	40.5	33.6	0.830
β-2-Naphthylalanine	3.0	39.7	33.5	0.844

* Concentration of chemicals was 100 ppm.
† Determinations made after 48 hr of treatment.

The β-naphthylalanines produced abnormal modification of root growth, besides causing inhibition of growth of the main root. In many instances root growth was characterized by the production of a

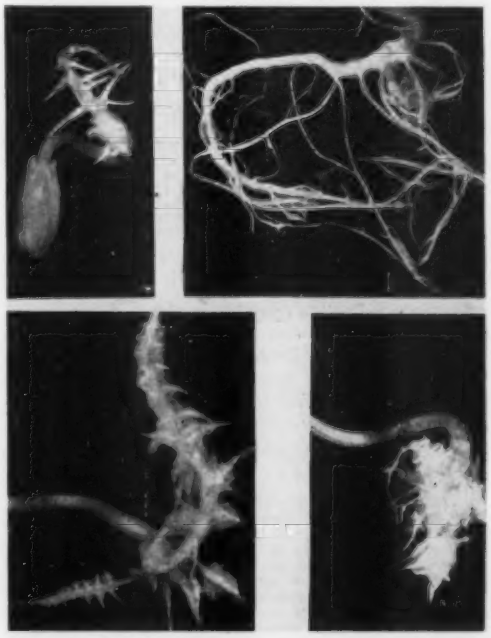

Fig. 1. Modification of root growth in cucumber seedlings induced by various naphthyl-β-alanines.

[1] Journal Article No. 1545 from the Michigan Agricultural Experiment Station, East Lansing.
[2] The β-naphthylalanines were supplied through the courtesy of Dr. Chester Stock of the Sloan-Kettering Foundation.
[3] Supported by the Horace H. Rackham Research Endowment of Michigan State College.

prodigious amount of root hairs. Beta-1-naphthylalanine, glycyl-β-1-naphthylalanine, β-3-thianaphthylalanine, and β-2-naphthylalanine produced the greatest inhibition of root growth of the naphthylalanines tested.

The respiratory quotient (RQ) was obtained by standard procedures (*5*). These studies show that the RQ of germinating cucumber seeds was increased by the naphthylalanines previously mentioned (Table 1), with the exception of β-2-naphthylalanine. The RQ of the β-1-naphthylalanine, glycyl-β-1-naphthylalanines, and β-3-thianaphthylalanine treated seed can be correlated to the growth pattern observed in the roots. These compounds produced an effect similar to that observed with 1-naphthaleneacetic acid. The RQ of the seeds treated with the carbobenzoxyglycyl-β-naphthylalanines and β-naphthylalanine was approximately the same as the control whereas the growth behavior was much less than that of the nontreated seeds.

A possible explanation for these results is that the β-2-naphthylalanines may be converted into naphthyleneacetic acid by a mechanism similar to the conversion of tryptophane to indoleacetic acid in plants.

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Received August 28, 1953.

The Role of Lactones in Flavor Deterioration of Milk Fat[1, 2]

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At an early stage in the storage deterioration of anhydrous milk fat a coconut-like flavor defect is evident (*1, 2*). This defect is manifest prior to typical oxidized fat flavors. Keeney and Doan (*1*) have suggested that lactones formed during deterioration of the fat are responsible for the off-flavor. This lipid-associated flavor defect is considered to be a principal factor limiting the acceptability of dry whole milk for beverage purposes (*2*).

[1] Authorized for publication 28 Nov., 1953, as paper No. 1845 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] Research undertaken in cooperation with the Quartermaster Food and Container Institute for the Armed Forces and assigned No. 457 in the series of papers approved for publication. The views or conclusions contained in the report are those of the authors and are not to be construed as reflecting the views or endorsements of the Department of Defense.

[3] We are indebted to Firmenich, Inc., and Fritzsche Bros., Inc., for supplying the lactones employed in this investigation.

Evidence from this laboratory has indicated that the flavor and odor properties of δ decalactone appear to be identical with those of the compound responsible for the coconut-like off-flavor of milk fat. A logical origin of this lactone is Δ^9-decenoic acid, a component of milk fat glycerides. This acid and Δ^9 dodecanoic and Δ^9 tetradecenoic acids occur in milk fat but apparently are absent in most other fats (*3–5*). Of a number of fats studied, including milk fat, lard, coconut, cottonseed, and soybean and peanut oils, only milk fat developed the off-flavor in question. A comparison of flavor deterioration in milk fat containing phospholipids and in that washed free of phospholipids showed development of the off-flavor in both media with equal facility. Extensive study also eliminated vitamin A, carotene, and other constituents of the unsaponifiable matter as possible origins of the flavor defect. Experiments involving low-temperature crystallization and hydraulic expression of milk fat demonstrated that the flavor defect develops most readily in the low-melting fraction. Hydrogenation of milk fat from an iodine value of 32 to a value of 12 completely prevented development of the off-flavor. These results are considered good evidence that the off-flavor originates from the unsaturated glycerides of milk fat. Observations on flavor deterioration of the methyl esters of oleic, linoleic, and linolenic acids dissolved in mineral oil revealed that these compounds yield only oily, tallowy types of off-flavors. However, storage deterioration of Δ^{10} undecenoic acid resulted in the production of an aroma reminiscent of the milk fat off-flavor. Grün and Wirth (*4*) have reported that Δ^9 decenoic acid slowly decomposes on standing and develops the odor of decalactone. This observation was confirmed. Δ^9 decenoic acid was prepared from milk fat according to the bromination-debromination method of Bosworth and Brown (*3*). The acid on standing several months gave rise to the odor of δ decalactone. In addition, it was noted that odor of the lactone could be developed in 48 hr by treating the decenoic acid with 70 percent sulfuric acid as shown by Grün and Wirth (*4*). Study of various fatty acid fractions from milk fat indicated that the C_{10} fraction is the only one that will develop the typical coconut-like aroma of dry whole milk either autocatalytically or in the presence of sulfuric acid.

Additional evidence that Δ^9 decenoic acid may be involved in the flavor defect was obtained from infrared studies of milk fat recovered from dry whole milk immediately after manufacture and after one month of storage. Among the significant spectral changes in storage was a loss in absorption in the vicinity of 3.2 μ. This change can be assigned logically to a loss of the vinyl group in Δ^9 decenoic acid (*6*).

In order for the lactones of decanoic acid to be of significance from a flavor standpoint, they should be detectable at relatively low concentrations. Results using four taste observers showed that the γ and δ decalactones are roughly equivalent in flavor potency and can be detected at a concentration of 1 to 2 ppm in milk. The γ lactones of decanoic and dodecanoic

acids impart fruity flavors to milk which also are suggestive of deteriorated milk fat.

Prevention of the coconut-like off-flavor in both anhydrous milk fat and dry whole milk has been investigated at this laboratory. Antioxygenic measures such as vacuum or inert gas packing and the addition of various antioxidants have proven ineffectual in preventing this off-flavor. The only satisfactory preventive noted thus far is low temperature storage (0° C or lower) of the product. Products stored in this manner for several months rapidly develop the off-flavor when they are warmed and held at 100° C for a few hours.

These results are of a preliminary nature and the problem is currently under intensive investigation. Most approaches to problems involving fat deterioration have embraced oxidative mechanisms as a basis. The present findings do not rule out the possibility that minute quantities of oxygen are required in production of the coconut-like off-flavor of milk fat. However, they also suggest a nonoxidative rearrangement of unsaturated fatty acids to lactones as the mechanism of this flavor deterioration.

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Received December 30, 1953.

Communications

Uptake of Radiozinc by Normal and Diabetic Rat Pancreas

INCREASING interest is being directed upon the possible importance of zinc in tissue metabolism and upon a role it may play in the etiology of diabetes. Scott and Fisher (*1*) found upon autopsy a difference amounting to one-half in the zinc content of diabetic pancreas as compared to the normal. This finding is in some conflict with that of Eisenbrand and his group who reported, on a fat-free basis, differences of some 17 percent (*2*) and later (*3*) reported no statistically significant difference. A Japanese group directed by K. Okamoto has for some time put forward the view that zinc is rather directly concerned in the production and course of diabetes. Recent papers (*4, 5*) discuss their findings based upon histochemical grounds. Considerable evidence is presented in support of their view that diabetes is reflected in a deranged apportionment of available zinc in the animal body. In their view, agents such as alloxan, oxine, and dithizone are diabetogenic because of their "specific affinity" for zinc. Root and Chen (*6*) report that 8-hydroxyquinoline possessed diabetogenic activity but discuss this action on grounds other than zinc metabolism. That zinc is present in relatively large quantities in normal pancreatic tissue has been confirmed, employing radiozinc, by Chaikoff and co-workers (*7, 8*) and by Heath and Liquier-Milward (*9*).

We felt it would be interesting to scrutinize the distribution of radiozinc in a series of normal and alloxan-induced diabetic rats. Blood sugar levels were employed to follow the course of diabetes. Accordingly, 2.0 ml of an isotonic saline solution of Zn^{65} chloride were injected intraperitoneally into each of 4 alloxan-induced diabetic rats. Twenty-four hr elapsed before the animals were sacrificed. Tissues were removed, ashed, and assayed for radioactivity, employing conventional radiochemical procedures. A wide variety of tissues were retained for counting and some whose behavior appears interesting are reported in Table 1. There appears to be considerably less Zn^{65} concentrated in the diabetic pancreas as compared with the normal. This finding would seem to offer sup-

TABLE 1. Distribution of Zn^{65}, percentage of administered dose found after 24 hr in various tissues.

Tissue	Normal rat %			Av.	Diabetic rat %				Av.
	1	2	3		1	2	3	4	
Pancreas	2.3	2.6	2.8	2.6	0.2	0.3	0.4	0.1	0.3
Liver	22.0	13.5	18.1	17.9	18.3	12.5	16.5	14.3	15.4
Stomach	6.4	5.1	5.6	5.7	4.7	3.4	2.0	5.7	4.0
Gastrointestinal tract									
upper	—	4.5	—	4.5	3.6	6.2	5.8	7.9	5.9
middle	3.5	3.8	5.7	4.3	4.3	7.4	5.4	3.4	5.1
lower	3.6	4.0	7.1	4.9	5.3	5.7	5.6	—	5.6
Kidney	2.0	2.0	0.8	1.6	2.6	4.5	3.9	3.7	3.7
Brain	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Heart	0.3	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.4
Spleen	—	0.3	1.1	0.5	0.3	0.3	0.2	0.2	0.3
Lung	0.7	0.8	0.7	0.7	0.9	0.8	0.6	0.8	0.8

port for the view that, at least for the case of alloxan, zinc metabolism is disturbed, and the present findings may be compared with those of the Japanese group (*4*). Differences of opinion have been recorded as to the actual location of zinc in pancreatic tissue. Fairly heavy ingestion of zinc is said to lead to deposition in the acinar portion (*10*), while other work implicates the islet tissue (*5*). In the present study the possibility presents itself that diabetic rat kidney takes up more radiozinc than normal kidney. Comment upon this phenomenon must be withheld at the present time.

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Received November 16, 1953.

Callus and Shoot Formation from Tomato Roots *in Vitro*

IT is known that shoots will arise from some plant callus tissues under certain cultural conditions; the development of plantlets from *Nicotiana* callus (*1–4*) and carrot callus (*4, 5*) has been described. White (*6*) reported that shoots arise from callus formed on isolated dandelion roots in culture. Since 1934, when White (*7*) first was able to subculture tomato roots for indefinite lengths of time, various workers have investigated root cultures of numerous strains of tomato. Through repeated subculturing, some of these lines have been maintained for a number of years. However, there has been no case reported of plants developing from such tomato roots. This paper reports the formation of callus and, subsequently, shoots from roots of a clone of *Lycopersicon peruvianum* (L.) Mill.[1] Root cultures in White's medium (*6*) were kept in the dark. Calluses and shoots were first noted on roots 15 days after subculturing. Most of the roots had a callus on the proximal end, and there were shoots visible on two of these calluses. In cultures originating from a segment of a root, rather than a root tip, there was a callus at one or both cut ends. Callus and shoot formation did not occur in another clone derived at the same time from the same seed sample and kept under the same conditions as the callus-forming clone. In later subcultures of the callus-producing clone, callus formation occurred on most of the roots, and shoot formation was frequent.

[1] The seed, harvested in 1950 from Line 2245, from which this root clone was obtained was furnished by the Ohio Agricultural Experiment Station, Wooster.

FIG. 1. ×5.

FIG. 2.

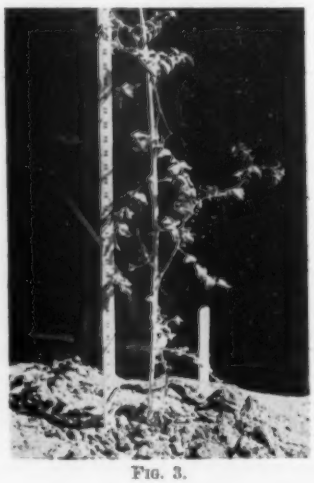

FIG. 3.

Some of the calluses with shoots were transferred to a modified Gautheret's medium containing 1% agar and 10 mg cysteine/liter, and the cultures were then kept under artificial light. On this medium, callus growth continued slowly but the shoots did not develop. When transferred to an identical medium, with addition of 40 mg adenine/liter, the shoots grew vigorously. One week after being transferred to this medium, the shoots had enlarged and become green (Fig. 1). During the next 2 wk, the plantlets increased in size and root systems developed (Fig. 2). The shoots were allowed to develop in the culture tubes until 5 or 6 leaves had expanded. One such plantlet, after being transferred first to vermiculite in a pot and later to soil, subsequently developed into a flowering plant (Fig. 3), which has been propagated vegetatively. No fruits have set.

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Received November 16, 1953.

Interaction of Chromate with Nucleic Acids in Tissues[1]

IN the course of work on a simple separation of basic proteins, in particular of histones in nucleoproteins, the effect of a number of anions on nucleoproteins was investigated. After treatment with solutions containing the chromate-bichromate system of ions, determinations of nucleic acids in hot trichloracetic acid extracts of tissues according to Schneider's method (*1*) were found to give much lower values than in extracts of tissues which were not treated with chromate. Analyses of the tissues after contact with either chromic acid or Zenker's solution and after extraction of lipids shows that the total P retained in the residue is much larger than in the residue after contact with trichloracetic acid. The increase in total P in the tissue was found to be the same order of magnitude as the decrease of nucleic acid phosphorus in the extracts. This seems to indicate that the low nucleic acid values in the extracts of chromate treated homogenates were actually due to the decreased extractibility of nucleic acids or of reaction products of nucleic acids with chromate. It seems unlikely, that the retention of nucleic acids is due to the formation of a simple, salt-like compound, e.g., between the weakly positively charged groups of the nucleic acids and the chromate anion, since the yellow color imparted by the chromate ion is completely removed before the extraction with hot trichloracetic acid. Also, the effect of chromate seems to be specific in so far as treatment of the tissues with other acids such as trichloracetic acid, metaphosphoric acid, sulfosalicylic acid, picric acid, or Bouin's solution does not decrease the extractibility of the nucleic acids. It seems more probable that a small portion of chromate is reduced as is evidenced by the greenish color of the residue and in this state it forms complexes with nucleic acids or nucleoproteins which are more resistant to the decomposition of trichloracetic acid.

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Received December 1, 1953.

[1] Work carried out with the aid of the American Cancer Society.

Listings of Unpublished Articles

BIBLIOGRAPHICAL lists submitted by applicants for research grants, fellowships, positions, or in other situations often contain references to articles not yet published. Sometimes the studies covered by these unpublished papers are among the most relevant ones for an evaluation of the application by a reviewing panel. Obviously only a reading of the papers themselves can give full knowledge of their content, but some minimum information could be obtained if a clear distinction were made in the listing of papers according to whether they are: (1) actually in press, that is, accepted by a journal; (2) submitted to a journal but not yet acted upon; or (3) not yet submitted to a journal and available only as manuscripts or still in preparation.

In (1) and (2) it would also help if the name of the journal and the approximate number of words were to be given. In any case, an abstract or summary of each unpublished paper should be provided. I suggest that in submitting bibliographies in connection with applications, some such procedure as the one proposed here should become general practice.

I also believe that editors should accept a bibliographical item listed as "in press" only when it falls into class (1) as defined above and only if it includes the name of the journal which will publish it.

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Received December 2, 1953.

Book Reviews

Advances in Enzymology and Related Subjects of Biochemistry, Vol. XIV. F. F. Nord, Ed. New York: Interscience, 1953. 470 pp. incl. cumulative index. Illus. $9.25.

In this rapidly progressing field, where textbooks have a way of becoming outdated before they can be published, these annual reviews have provided an indispensable reference source for the expert as well as for the novice in the field. Volume XIV constitutes a notable addition to this series.

The currently popular theories concerning the role of adenosine triphosphate in energy production and metabolism are reviewed by T. Bücher in a chapter entitled Energy Transport in Living Cells. Also briefly discussed are a number of concepts which have received little attention from enzymologists, including entropy changes, the contribution made by degrees of freedom, and the role of hydrogen bonded systems in proton transport. It is unfortunate that some of these are not given more thorough treatment.

In Pantothine and Related Forms of the *Lactobacillus bulgaricus* Factor (LBF), E. E. Snell and G. M. Brown provide a very thorough review of the chemistry and biological activity of these compounds, their relationship to coenzyme A, and their microbiological activity.

Two chapters are concerned with the enzymatic reactions involving phenylalanine and tyrosine. In Metabolism of Phenylalanine and Tyrosine, A. B. Lerner considers a number of reactions involving these amino acids, including their oxidation and melanin formation, their relation to intermediates of the citric acid cycle, hormone production, and the synthesis of the aromatic nucleus. The author's mechanism for tyrosinase action, admittedly controversial, might have been supported by a more extensive review of the evidence. I. W. Sizer discusses the Oxidation of Proteins by Tyrosinase. Methods of study and numerous examples are cited.

W. Langenbeck contributes a chapter entitled Chemistry of Organic Catalysis reviewing a number of catalytic mechanisms in which intermediate complexes are formed. Enzymatic reactions are interpreted in the light of these organic model systems.

An excellent review of Enzymatic Isomerization and Related Processes is provided by L. F. Leloir. Racemization reactions, sugar transformations, and phosphate ester interconversions are covered. The need for further study of isomerization reactions is emphasized.

In a controversial article, O. Hoffmann-Ostenhof offers suggestions for a more rational classification and nomenclature of enzymes. This is a commendable effort to systematize enzyme nomenclature which contains much justified criticism of currently used names, but it is doubtful that the system suggested will receive wide acceptance. The names proposed, however rational, are often very cumbersome. The use of arrows in spelling is objectionable since these cannot be designated in conversation. Despite these and other deficiencies, the article contains a number of valuable rules worthy of consideration.

Several new techniques for the study of protein structure are the subject of a thorough and well-written review by P. Desnuelle. Included are sections on separation and identification of amino acids in protein hydrolysates and methods for the study of amino acid sequences in proteins. Older as well as newer techniques are discussed in detail. The section on protein purification duplicates material covered in later chapters.

In Adsorption Studies of Enzymes and Other Proteins, C. A. Zittle covers the theory of adsorption phenomena and describes results obtained with a number of old and new adsorbents. Unfortunately, as the author indicates, the results have not measured up to early expectations. This review would be of more value to the uninitiated had it included a more critical evaluation of the various adsorbents and eluants which have been employed for protein purification.

In the final chapter on principles and procedures in the isolation of enzymes, S. Schwimmer and A. B. Pardee make a valuable attempt to "systematize the multitude of procedures" successfully used for enzyme purification. The authors suggest methods for standardizing the reporting of results of enzyme purification and for assessing the relative merits of purification steps.

The volume is well edited and quite free of typographical errors, although several serious misprints have been incorporated. The structure of reduced lactoflavin (p. 180) is incorrectly represented.

B. L. Horecker

National Institute of Arthritis and Metabolic Diseases National Institutes of Health, Bethesda, Maryland

New Books

The Atomic Submarine and Admiral Rickover. Clay Blair, Jr. New York: Henry Holt, 1954. 277 pp. + plates. $3.50.

Experimental College Physics: A Laboratory Manual. 3rd ed. Marsh W. White and Kenneth V. Manning. New York–London: McGraw-Hill, 1954. 347 pp. Illus. $5.00.

The Unique Influence of The Johns Hopkins University on American Medicine. Richard H. Shryock. Copenhagen, Denmark: Ejnar Munksgaard, 1953. 77 pp. Dan. kr. 14.00; bound: 17.50.

Curious Creatures. Erna Pinner. New York: Philosophical Library, 1953. 256 pp. Illus. $4.75.

Science in Alaska, 1951. Proceedings of the Second Alaskan Science Conference, AAAS, Alaska Division. (Order from: Dr. Troy L. Péwé, Box 4004, College, Alaska.) 362 pp. $3.00.

The Major Features of Evolution. George Gaylord Simpson. New York: Columbia Univ. Press, 1953. 434 pp. Illus. $7.50.

General Virology. S. E. Luria. New York: Wiley; London: Chapman & Hall, 1953. 427 pp. Illus. $8.50.

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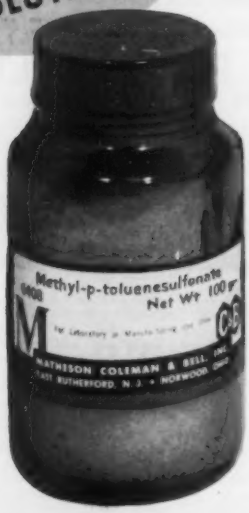

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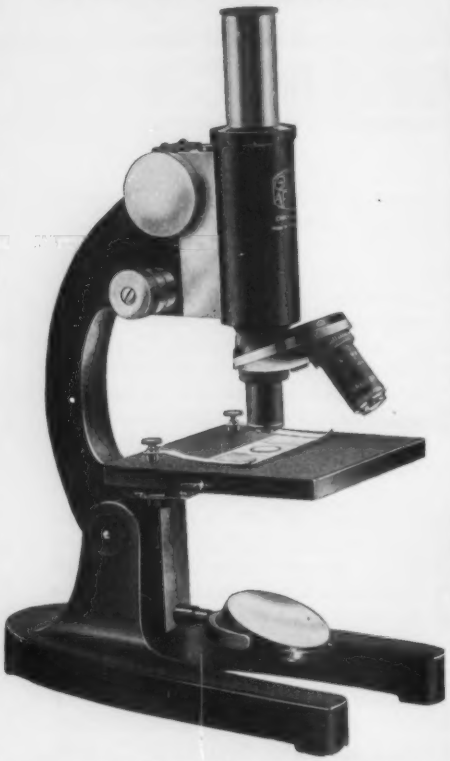

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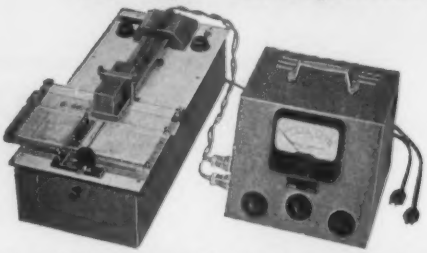

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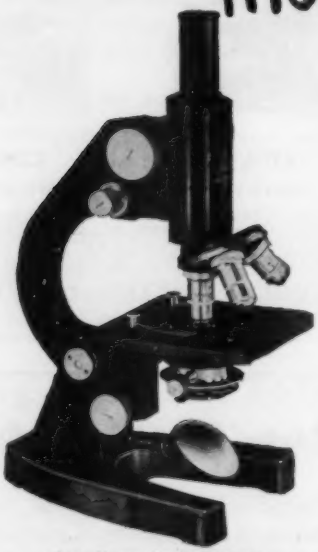

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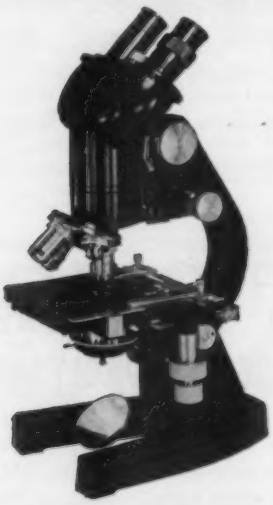

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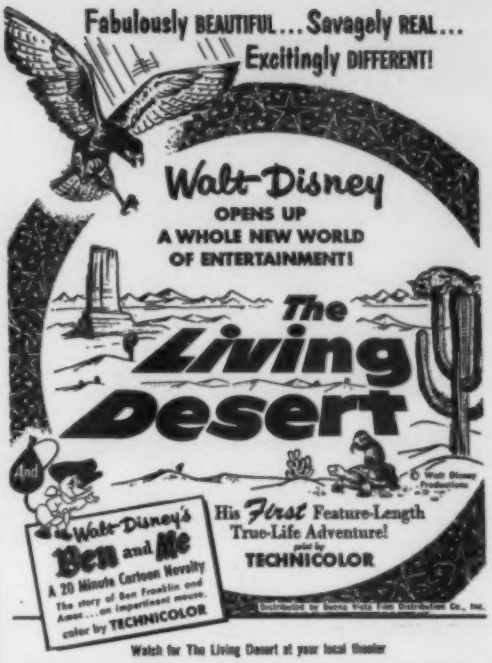

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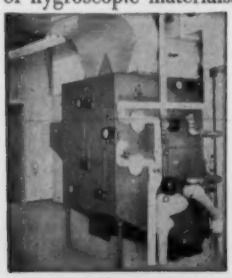

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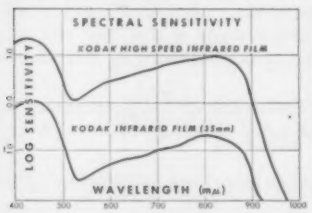

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Dr. Linnell, who covers direct current techniques, constructed a photoelectric photometer still in use at the Boyden station in South Africa, and while at Harvard used this in the study of the faint and unusual eclipsing variable, UX Ursae Majoris. His present work involves the development of techniques using subminiature tubes.

Dr. Hall—alternating current techniques—is co-discoverer of the phenomenon of the polarization of the light of certain stars, and was the first astronomer to demonstrate the value of refrigeration of photocells.

Dr. Blitzstein constructed the first pulse-counting photometer for astronomical use and applied it to the observation of eclipsing variables.

Although Dr. Bengt Stromgren of the Yerkes and McDonald Observatories reviewed foreign developments at the Philadelphia meeting, this volume includes papers written by MM. Lellemand and Lenouvel on work at the Observatoire de Haute Provence and by R. O. Redman, Director, and G. G. Yates of the Observatory at Cambridge University.

Dr. Walraven of Leiden describes the work with servomechanisms carried out by him at the Union Observatory in Johannesburg.

Dr. Whitford, who supplies the critical summary and evaluation of future developments, has been considered an outstanding authority in this field for many years. His introduction of the constant deflection method using electrometer tube techniques marked a major advance.

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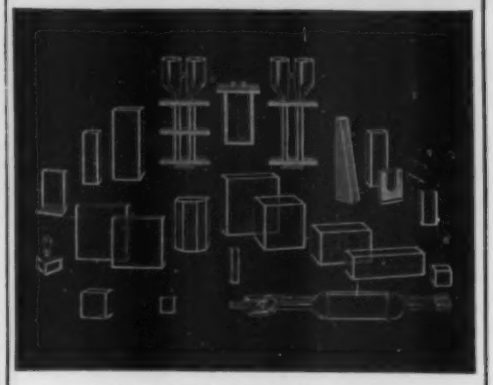

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8–10. American Inst. of Chemical Engineers, Washington, D.C. (S. L. Tyler, 120 E. 41 St., New York 17.)

8–10. The Wildlife Soc., annual, Chicago, Ill. (G. A. Petrides, Dept. of Fisheries and Wildlife, Michigan State College, East Lansing.)

9–12. American Mosquito Control Assoc., annual, Atlantic City, N.J. (R. E. Dorer, 301 Essex Bldg., Bank & Plume Sts., Norfolk, Va.)

11–13. American Orthopsychiatric Assoc., New York, N. Y. (M. F. Langer, 1790 Broadway, New York 19.)

11–13. Kappa Delta Pi, Lafayette, Ind. (E. I. F. Williams, 277 E. Perry St., Tiffin, Ohio.)

11–13. National Wildlife Federation, annual, Chicago, Ill. (L. F. Wood, 232 Carroll St., NW, Washington 12, D. C.)

15–19. National Assoc. of Corrosion Engineers, annual, Kansas City, Mo. (A. B. Campbell, 1061 M & M Bldg., Houston 2, Tex.)

16–17. Symposium on Monte Carlo Methods, Gainesville, Fla. (H. A. Meyer, Univ. of Florida, Gainesville.)

18. Inst. of Mathematical Statistics, Eastern regional, Gainesville, Fla. (H. A. Meyer, Univ. of Florida, Gainesville.)

18–20. American Physical Soc., Detroit and Ann Arbor, Mich. (K. K. Darrow, Columbia Univ., New York 27.)

20. The Biochemical Soc., annual, London, Eng. (F. L. Warren, Biochemistry Dept., London Hospital Medical College, London W. 1.)

21. International Assoc. for Dental Research, French Lick, Ind. (E. H. Hatton, 311 E. Chicago Ave., Chicago 11, Ill.)

22–24. American Assoc. of Dental Schools, annual, French Lick Springs, Ind. (M. W. McCrea, 42 S. Greene St., Baltimore, Md.)

22–25. Inst. of Radio Engineers, annual, New York City. (E. K. Gannett, 1 E. 79 St., New York.)

24–1. American Chemical Soc., 125th national, Kansas City, Mo. (R. M. Warren, 1155 16 St., NW, Washington, D.C.)

25–27. Alpha Epsilon Delta, 10th national, Bloomington, Ind. (M. L. Moore, 7 Brookside Circle, Bronxville, N.Y.)

25–27. Optical Soc. of America, spring, New York City. (A. C. Hardy, Massachusetts Institute of Technology, Cambridge 39.)

25–27. Symposium on the Origins of Resistance to Drugs, Washington, D.C. (M. G. Sevag, Dept. of Microbiology, School of Medicine, Univ. of Pennsylvania, Philadelphia 4.)

26–28. American Assoc. of Physical Anthropologists, annual, Yellow Springs, Ohio. (J. L. Angel, Jefferson Medical College, 307 S. 11 St., Philadelphia 7, Pa.)

April

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